Introduction to the Tools and Mechanics of Systematic Planning

ConSoil 2008 - Milan

Stephen Dyment

USEPA

Technology Innovation Field Services Division

dyment.stephen@epa.gov

Robert Howe

Tetra Tech EM Inc.

robert.howe@ttemi.com

Technical Session Objectives

- Provide an overview of the systematic planning process used under a Triad Approach
- Expose participants to existing tools, strategies, and templates for successful systematic planning
  - » Highlight a “crosswalk” between critical project elements and available tools or strategies
- Showcase techniques to enhance stakeholder acceptance, project team functionality, technical planning, and uncertainty management
- Present systematic project planning examples to underscore tangible benefits

Past Strategies: "define the nature and extent of contamination" without using decision goals or a site-specific CSM to guide data collection

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One-size-fits-all lab analyses

2 3

2 1

We need more information

2

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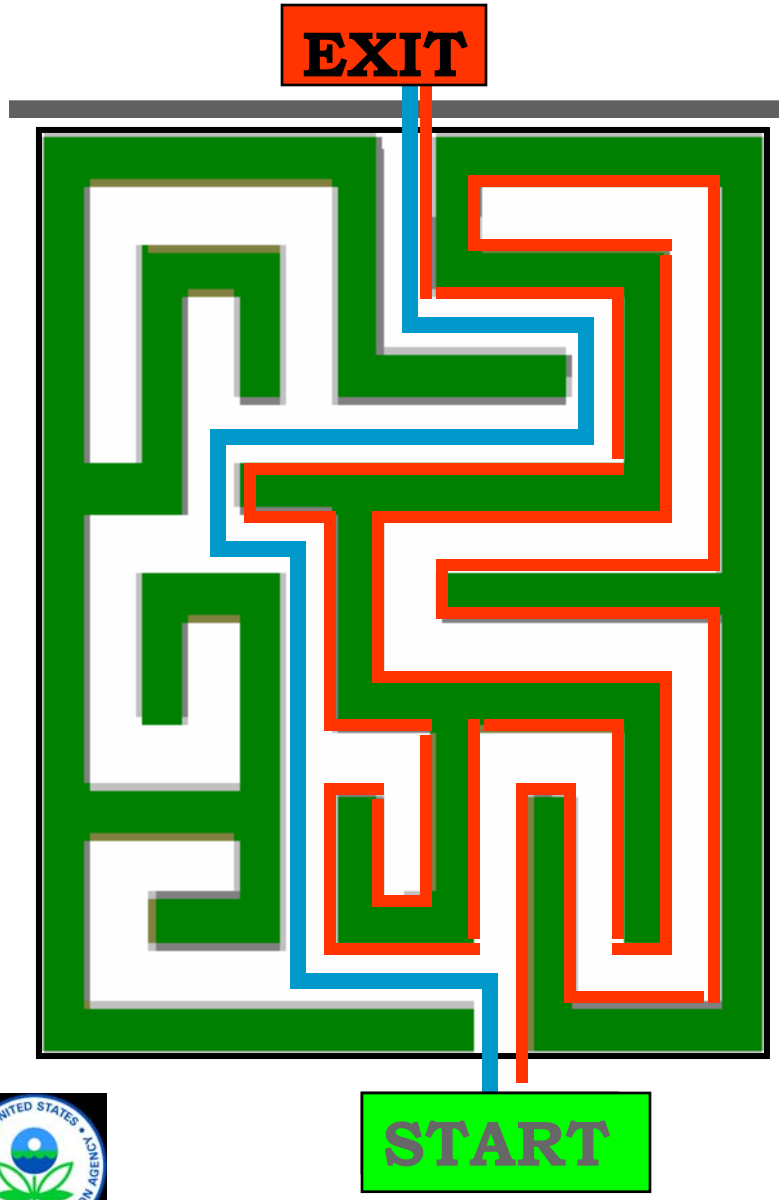
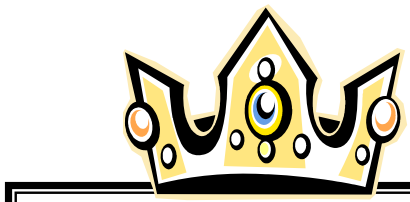
EPA Studied Successful, Cost-Saving Projects



Tactics proved successful:

- Detailed, specific planning to identify issues, exit & strategy
- Multidisciplinary team
- Stakeholders involved
- Project-specific CSM to identify & fill data gaps in real-time; understand contamination
- Creating opportunities for real-time decision-making
- Real-time, high-density data tools

3 Elements of the Triad Approach



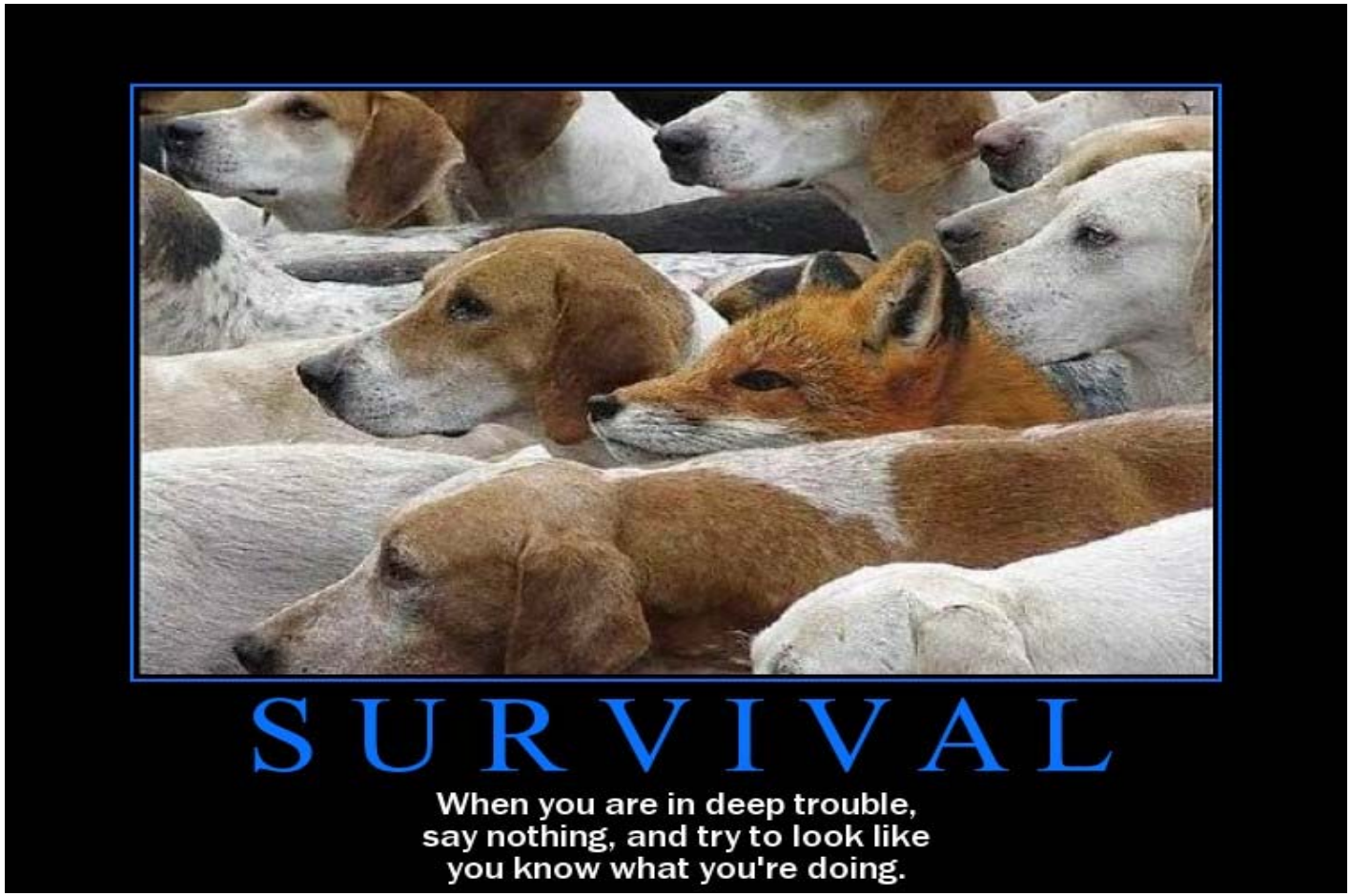
Systematic Project Planning

Dynamic Work Strategies

Real-time Measurement Technologies

Everybody Does Project Planning Don't They?

- Sometimes you have to slow down to go faster!

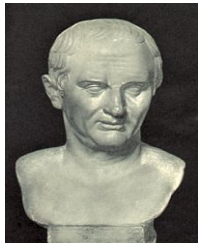


Triad Systematic Project Planning- More Comprehensive

- Data Quality Objectives
  - »Focus on analytical quality
- What about sampling, spatial, temporal, matrix variabilities?
  - »Most often the largest contributors to variability and uncertainty
- What about social, economic, and political factors?
  - »Technical challenges are often easy compared to person to person dynamics

First Steps

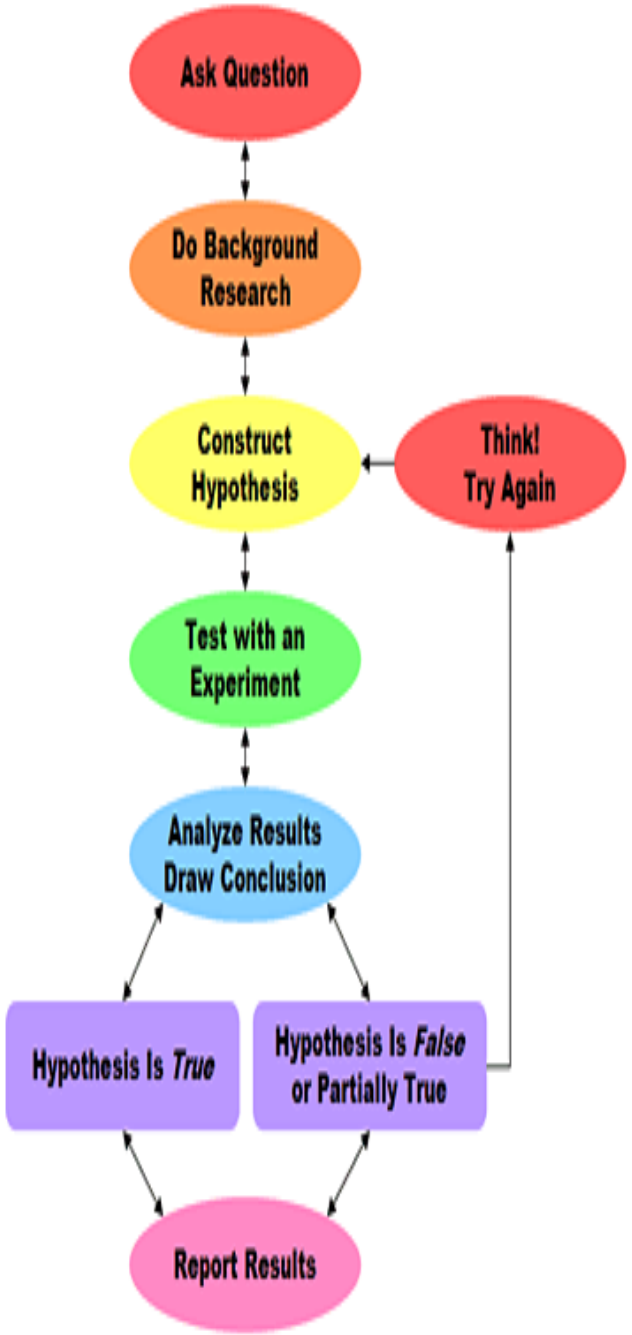
"Before beginning, plan carefully."
Marcus Tullius Cicero



- Evaluate the viability of best management approaches embodied in the Triad
- Assemble the multidisciplinary technical team
  - »Develop a preliminary conceptual site model (CSM)
- Engage all stakeholders
  - »They must be invested/involved, accountable
- Prepare for systematic planning meetings
  - »See SPP checklist, BMP inventories

The Preliminary CSM

- CSM is THE essential planning tool
- Captures what you know, what you think you know, what you know you don't know, etc. about your site
- Becomes the basis for future data and information collection
- Often represented as a picture or cartoon, however should be a combination of text, figures, tables, models, and more



The CSM "Harmonizes" the Project

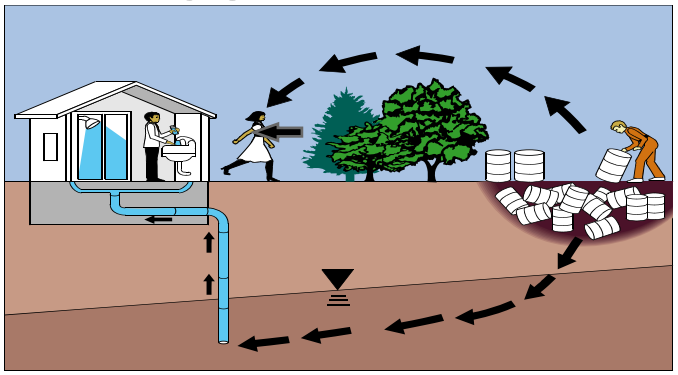
Lack of clarity here

Reuse Plans, Goals, Outcomes

Impact

…means uncertainty here

CSM



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Decisions:
- Exposure risk
- Cleanup goals
- Data (type, quality)
- Tolerable errors

…which means no foundation for agreement here

Determine

…or here

Approaches to:
- Assessment
- Investigation
- Cleanup Design, Implementation
- Closeout, Long-Term Operations and Maintenance

Tools for:
- Sampling, Analysis, Interpretation
- Cleanup/Remediation
  - Containment
  - Cleanup
  - Controls
- Monitoring, Maintenance

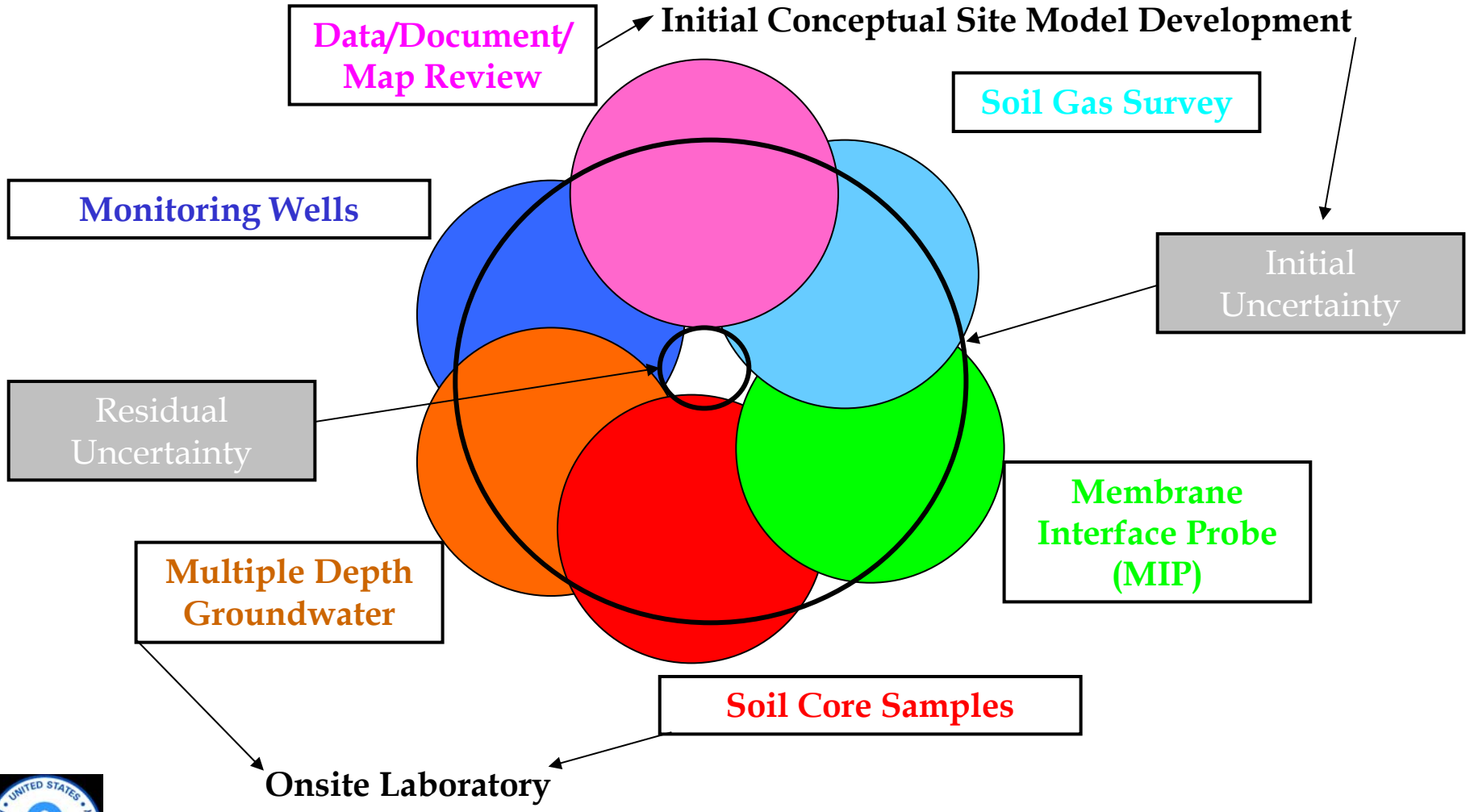
Engaging Stakeholders

Managing Uncertainty

"Doubt is not a pleasant condition, but certainty is absurd." **Voltaire**

- CSMs – seek, recognize, identify, quantify, and manage uncertainties
  - » Technical - sampling density, matrix heterogeneity, method variability, risk assessment
  - » Regulatory - changing project managers, standards
  - » Fiscal - budget cycles, re-development, material cost
- During systematic planning - use uncertainty tables and prioritize contingencies
- Important note - data needs change at different points in the characterization and clean-up process

Conceptual Site Model, Collaborative Data Sets and Uncertainty Management



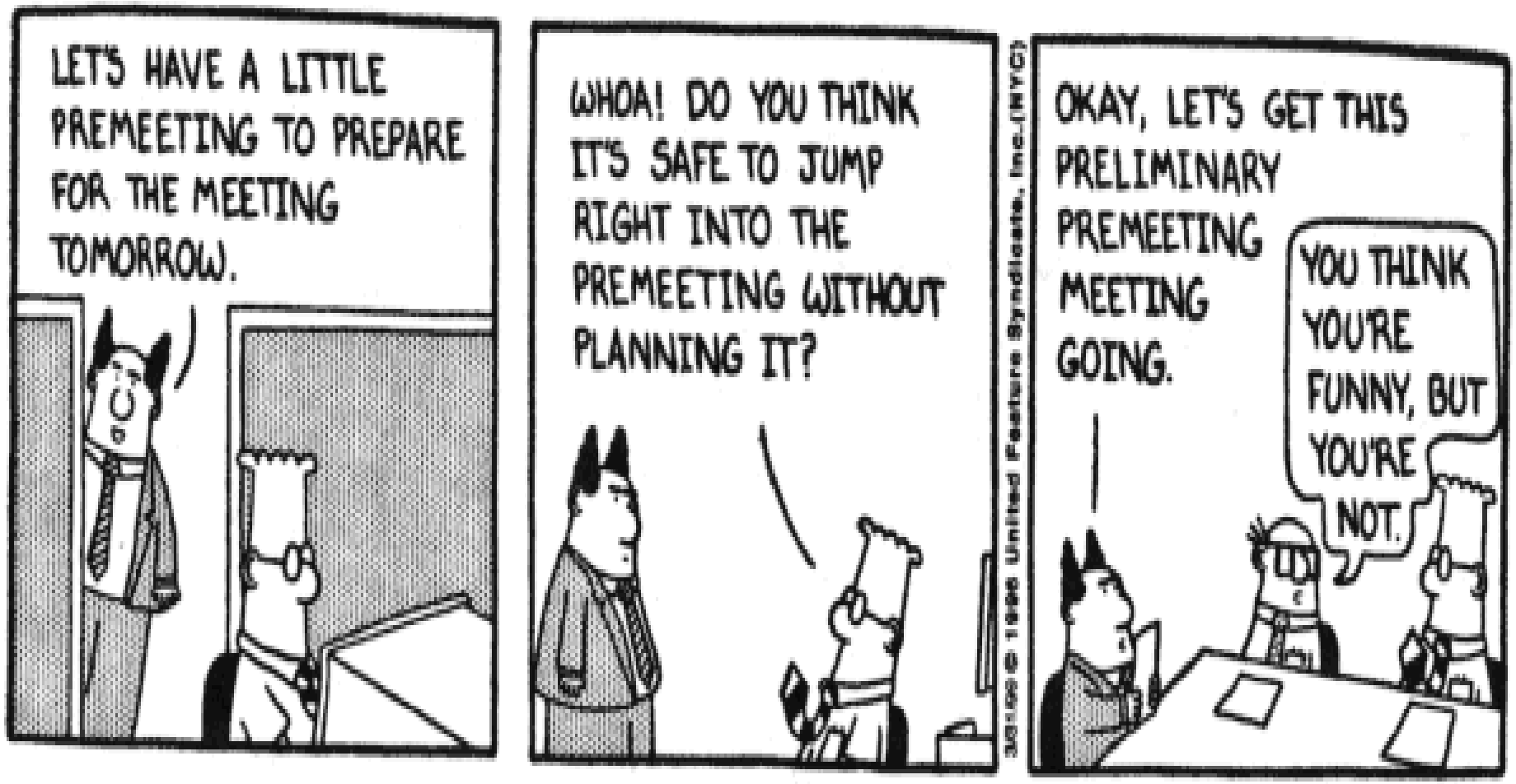
Adapted from ITRC Triad Course

Prioritizing Contingencies

How do you determine what level of resources to use to address a potential contingent action?

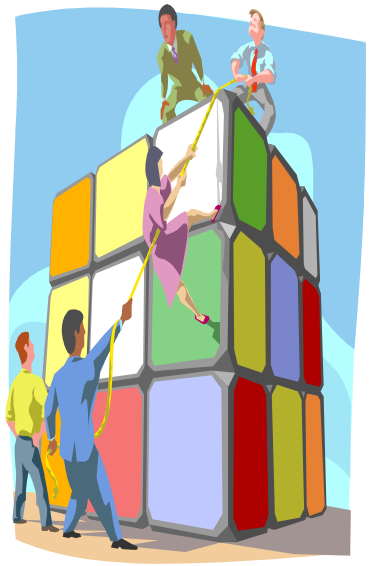
High Project Vulnerability	**X**	**High Likelihood of Occurrence**	**=**	**Apply Considerable Resources**
High Project Vulnerability	**X**	**Low Likelihood of Occurrence**	**=**	**Apply Significant Resources**
Moderate Project Vulnerability	**X**	**Low Likelihood of Occurrence**	**=**	**Apply More Limited Resources**

Systematic Planning Meetings- Maximize Your Effectiveness



The Importance of Social Capital

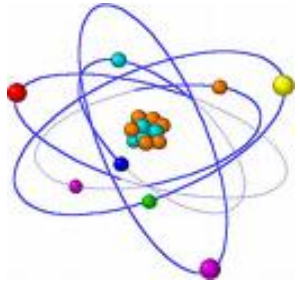
- The “people” aspects are just as critical to project success as science and technology
- Term includes trust, tolerance, collaboration toward a common project vision
- Systematic planning encourages participants to:
  - » Share knowledge and insights
  - » Test assumptions, beliefs, perspectives
  - » Evaluate legal, budgetary, technical constraints
  - » Achieve clarity about where disagreements lie
  - » Negotiate over concerns and interests



The "Big Picture"
Outputs of Systematic Planning

- Consensus on preliminary CSM
  - » If disparities exist, a plan to address competing site visions
- Develop site exit strategy
  - » Where are we going?
  - » How do we get there?
  - » How do we know when objectives are achieved?
  - » When is it time to change direction or address unknowns?
- Define roles/responsibilities, develop tentative project schedule
- Explore practical considerations
  - » Regulatory, budget, re-use, political pressures, likely remedies, important pathways/receptors
- Agree upon mechanism for decision making when consensus is not achievable or process needs re-visiting

Detailed Systematic Planning Outputs

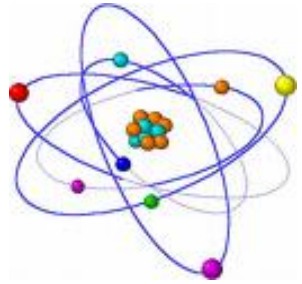


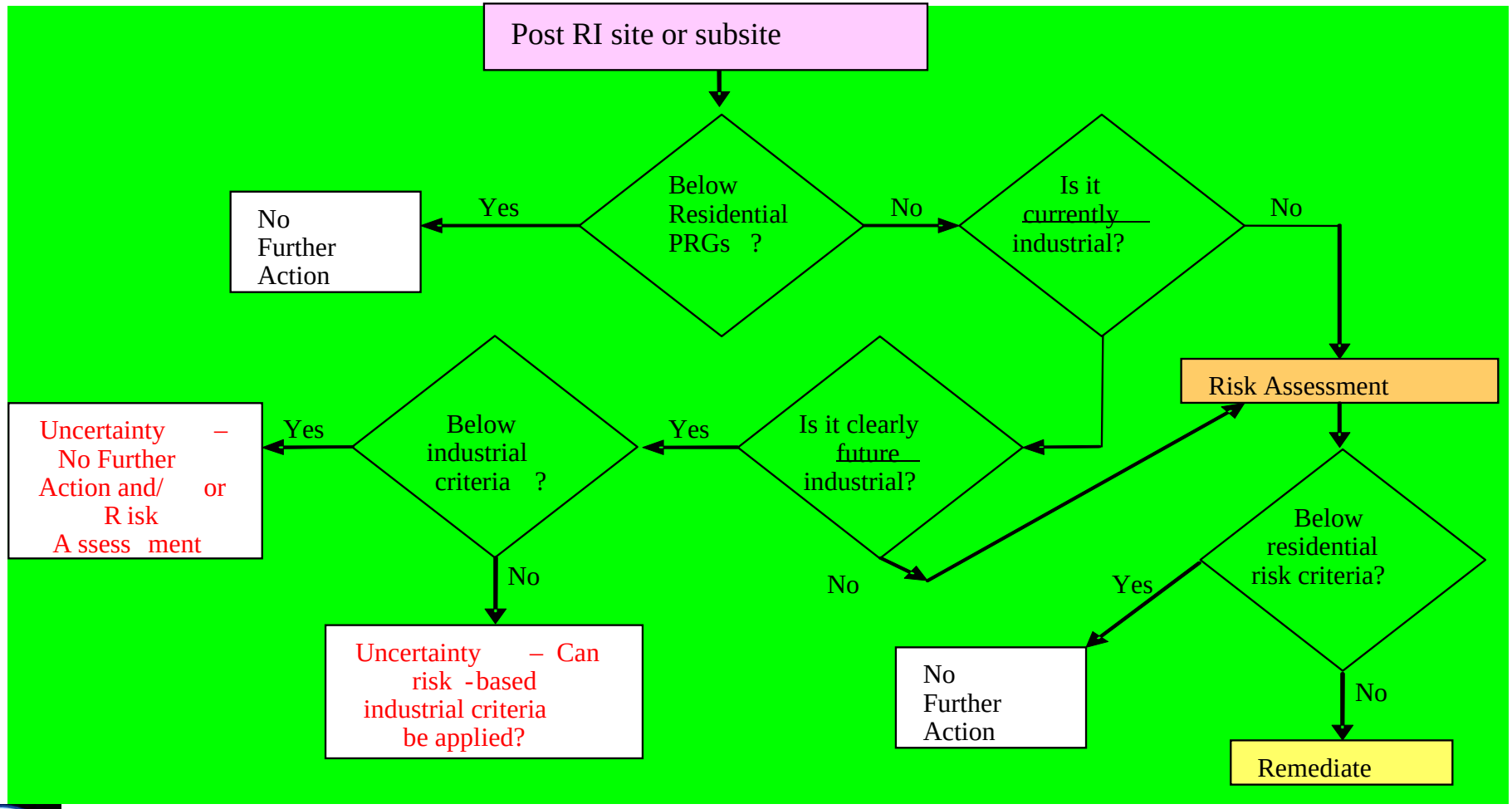
Jackson Ceramix

Uncertainties for which sampling is required (i.e., to be incorporated into Work Plan)

No.	Uncertainty	Recommended Resolution	Type of information required	Quality	Quantity	Responsibility	Priority
1	Acid mine drainage upgradient?	Include during initial surface water sample collection/analysis	Area surface water pH, During wet and dry events? Sulfur and Boron isotope geochemistry?	YSI, Horiba, multiple parameter surface water probe. ASTM University	TBD Determine necessity?	CDM R3 (Bruce, et al) Tetra Tech	M
2	Ecological toxicity? Bioavailability?	Observation of earthworm locations in relation to Pb concentrations Earthworm collection	Laboratory toxicity testing. ASTM method Analysis of corresponding soil via AA, ICP, or XRF?	ASTM Get copy of method. SW-846 XRF?	Transect across concentration gradient	CDM R3 (Bruce, Kathy, et al)	H
3	XRF and ICP correlations	TAL (Metals) XRF (Unit?) Encourage CDM to evaluate newer hand held units to allow real time measurement in the field.	Demonstration of method applicability. Sample prep	SW846 or CLP. XRF CDM SOP?	10-20% of total XRF samples. Front loaded QC during DMA	CDM, EPA HQ	H

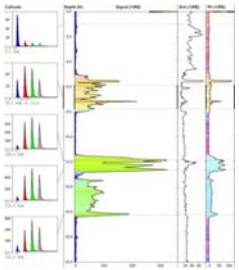
Detailed Systematic Planning Outputs

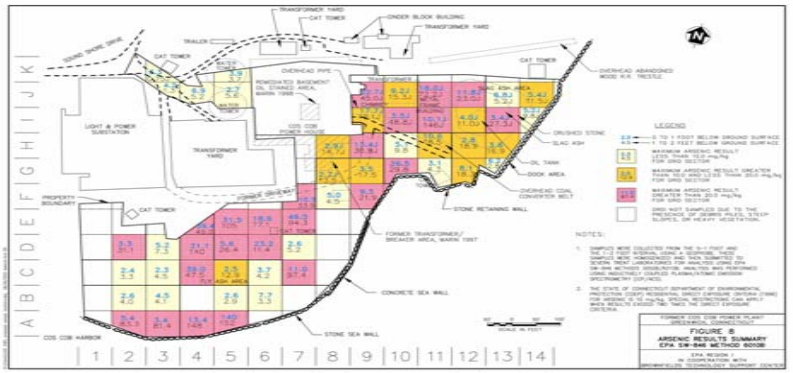




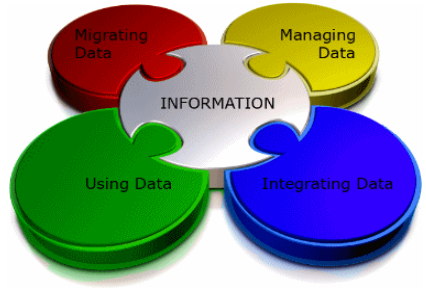
Detailed Systematic Planning Outputs

- Explore available sampling designs and analytical tools - DMAs
  - »Statistical sampling designs, composites, multi-increment samples
  - »Field analytics, direct sensing tools, geophysics, etc.
  - »Collaborative data sets





Detailed Systematic Planning Outputs



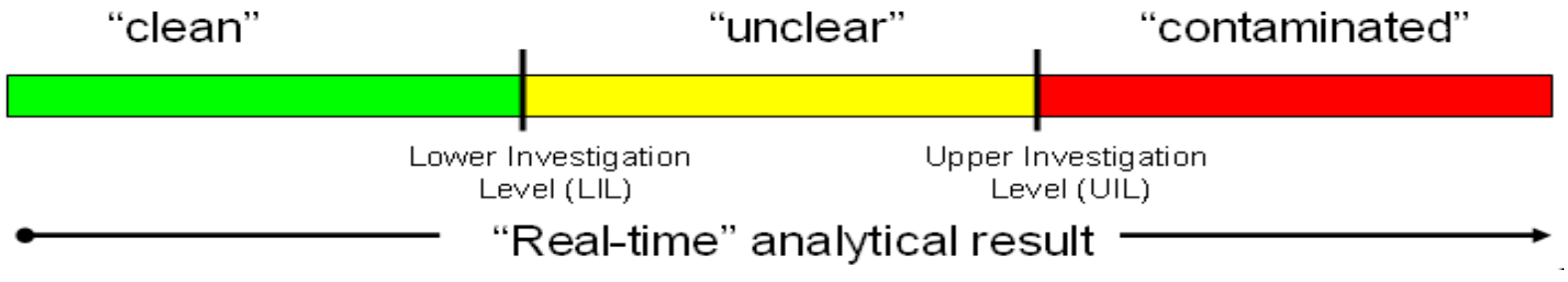
- Develop a data management plan - see “Critical Role of Data Management” session
  - »Particularly critical for dynamic work strategies
  - »Need an effective strategy to deal with large amounts of data and interpret in real time
  - »Bridge the gap between instrument outputs and visualization or DST inputs
  - »Data management strategies can be evaluated and optimized based on DMA

Detailed Systematic Planning Outputs

- Never too early to think about likely remedies
- Define applicable or relevant and appropriate requirements (ARAR)
  - » Within your program what are the legal requirements governing remedial actions?
- Define remedial action objectives (RAO)
- Performance metrics
  - » Critical to know if your remedy is working and when to stop or change direction if it is not
- Review requirements
- Contingency priorities

Planning and Implementing a Demonstration of Method Applicability

- Concept founded in SW-846, performance based measurement (PBMS) initiative
- Initial site-specific performance evaluation
  - » Analytical and direct sensing methods
  - » Sample design, sample collection techniques, sample preparation strategies
  - » Used to select information sources for field and off-site
- Goal is to establish that proposed technologies and strategies can provide information appropriate to meet project decision criteria

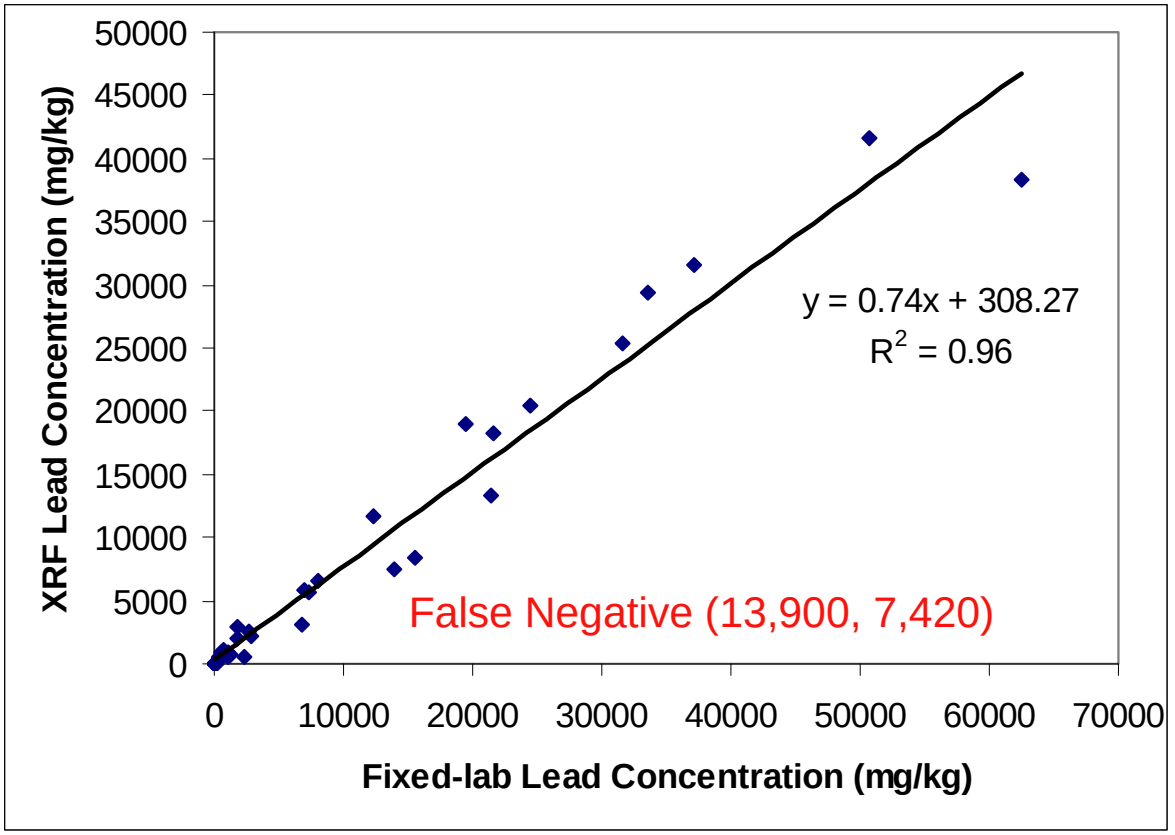


DMA Implementation

- Effectiveness - Does it work as advertised?
- QA/QC issues
  - » Are DLs and RLs for site matrices sufficient?
  - » What is the expected variability? Precision?
  - » Bias, false positives/false negatives?
  - » How does sample support effect results?
  - » Develop initial relationships of collaborative data sets that provide framework of preliminary QC program
- Matrix Issues?
- Do collaborative data sets lead to the same decision?
- Assessing alternative strategies as contingencies

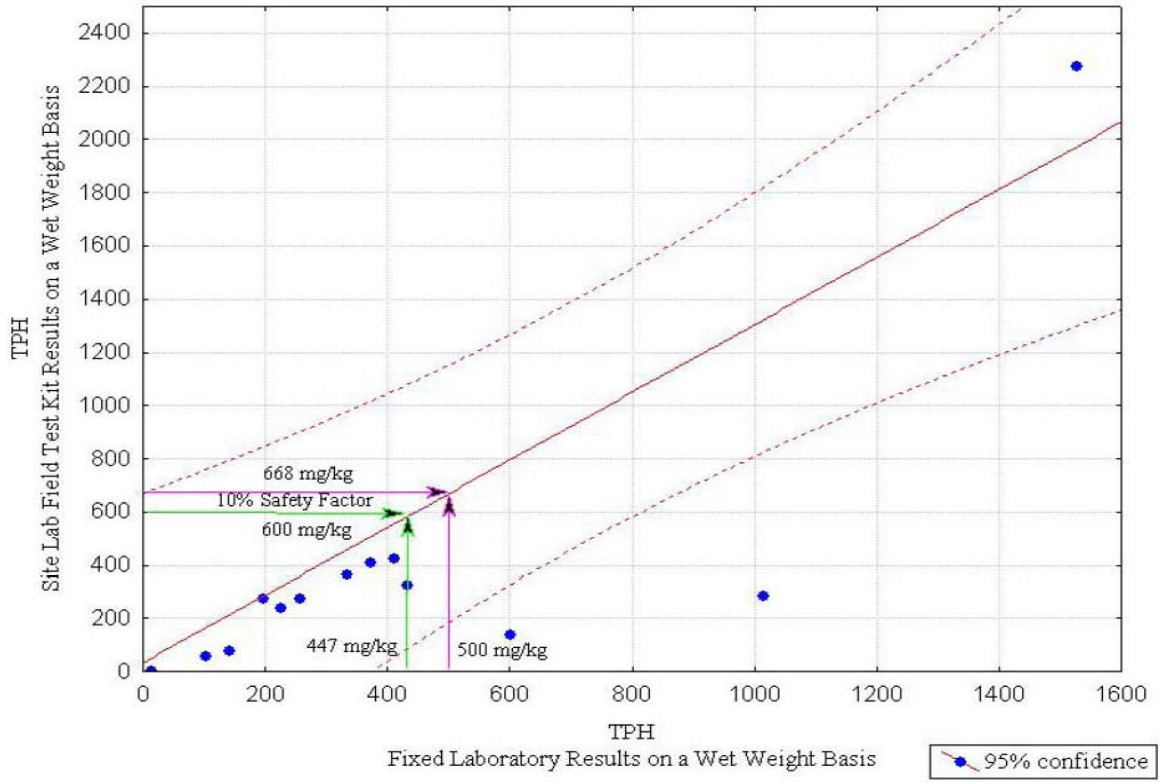
Demonstrations of Method Applicability – Examples

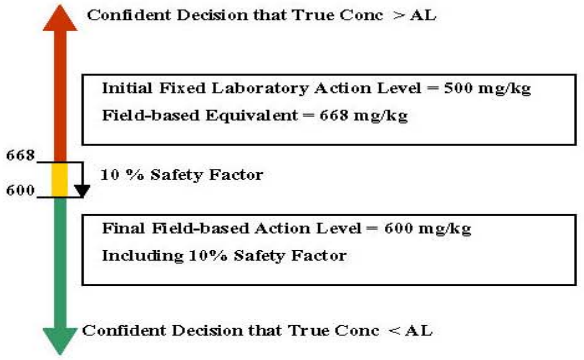
- Sometimes the results correlate very well!
- Field-based action level (FBAL) for XRF is easily calculated
- If the true action level is 10,000 mg/kg, the FBAL is 7,700 mg/kg
- One false negative for 40 data points (2.5%), no false positives!



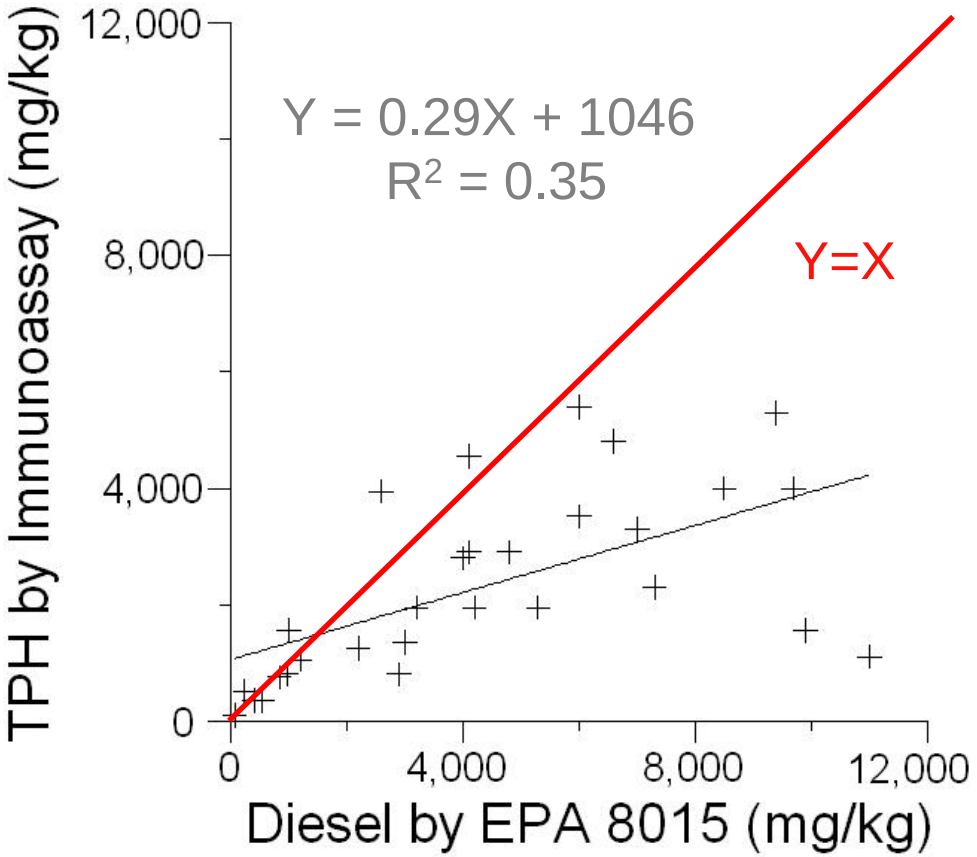
Field-Based Action Levels and Safety Factors

Development of Field-based Action Level for TPH When No Historical Data is Available



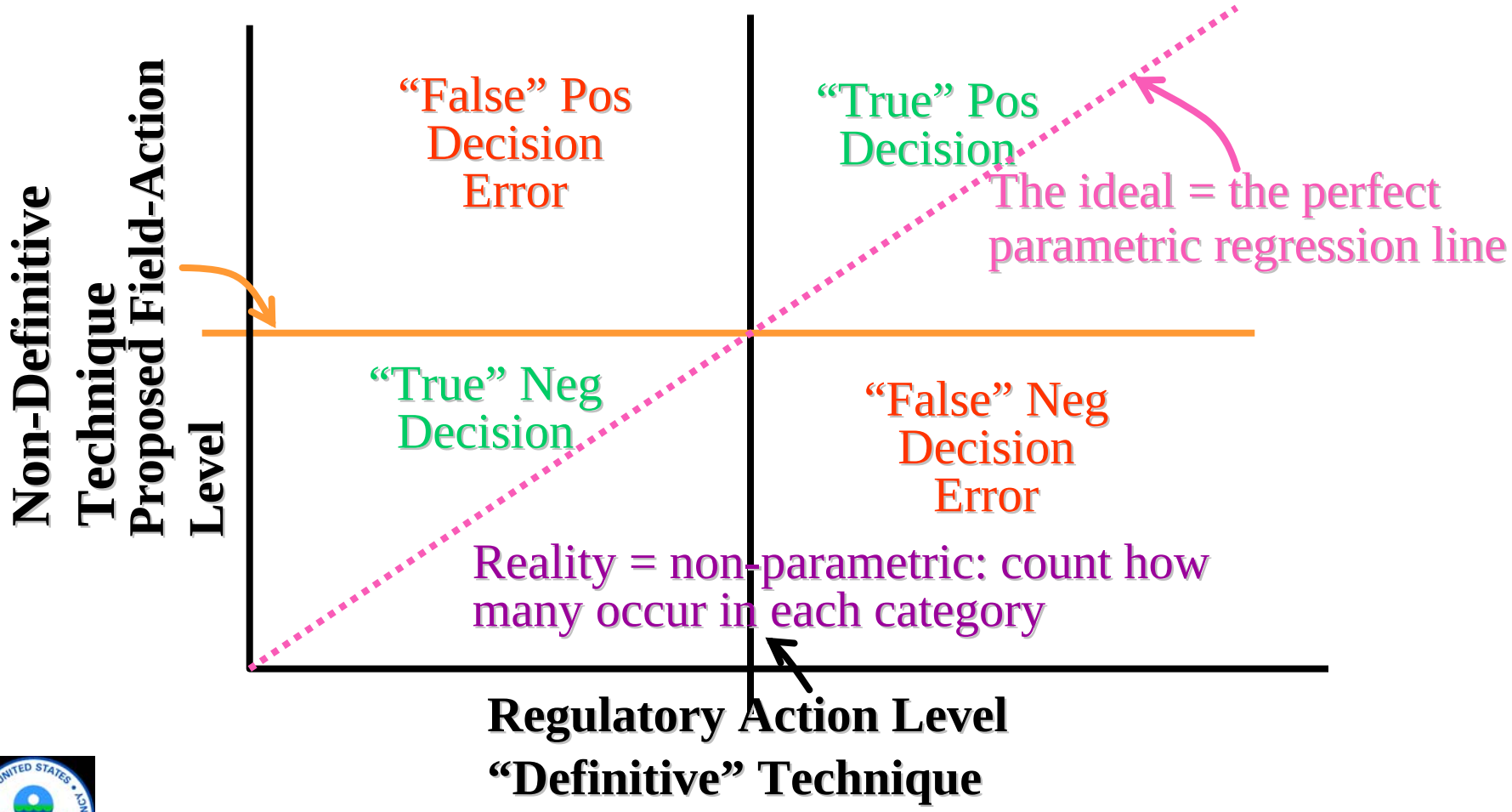


Correlations Are Not Always Good, But Data May Still Be Adequate



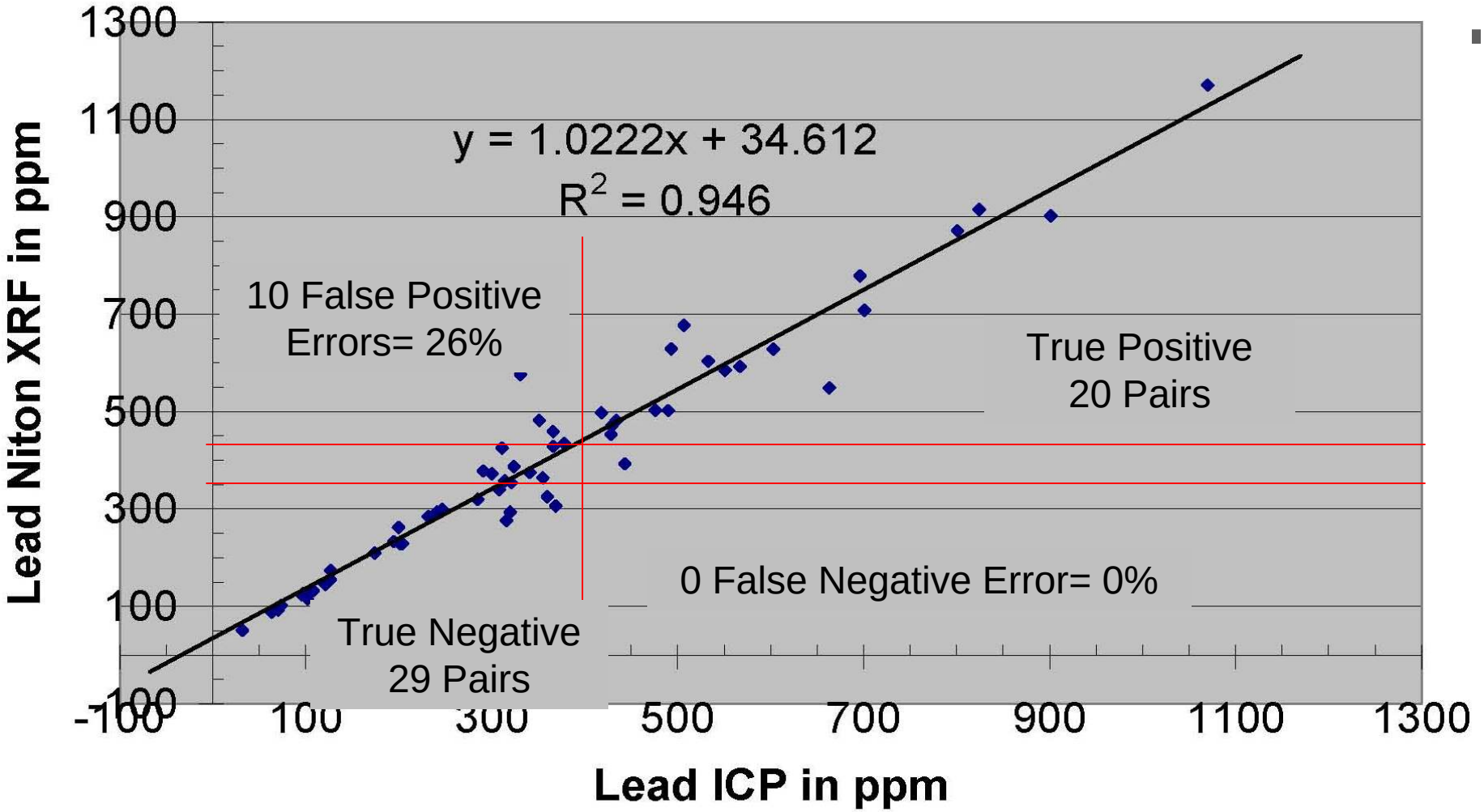
- DMA with poor correlation
- Red line is 1:1 direct correlation line
- Most immunoassay results are lower than 8015 results
- At first glance, data appears unusable

Non-parametric Techniques

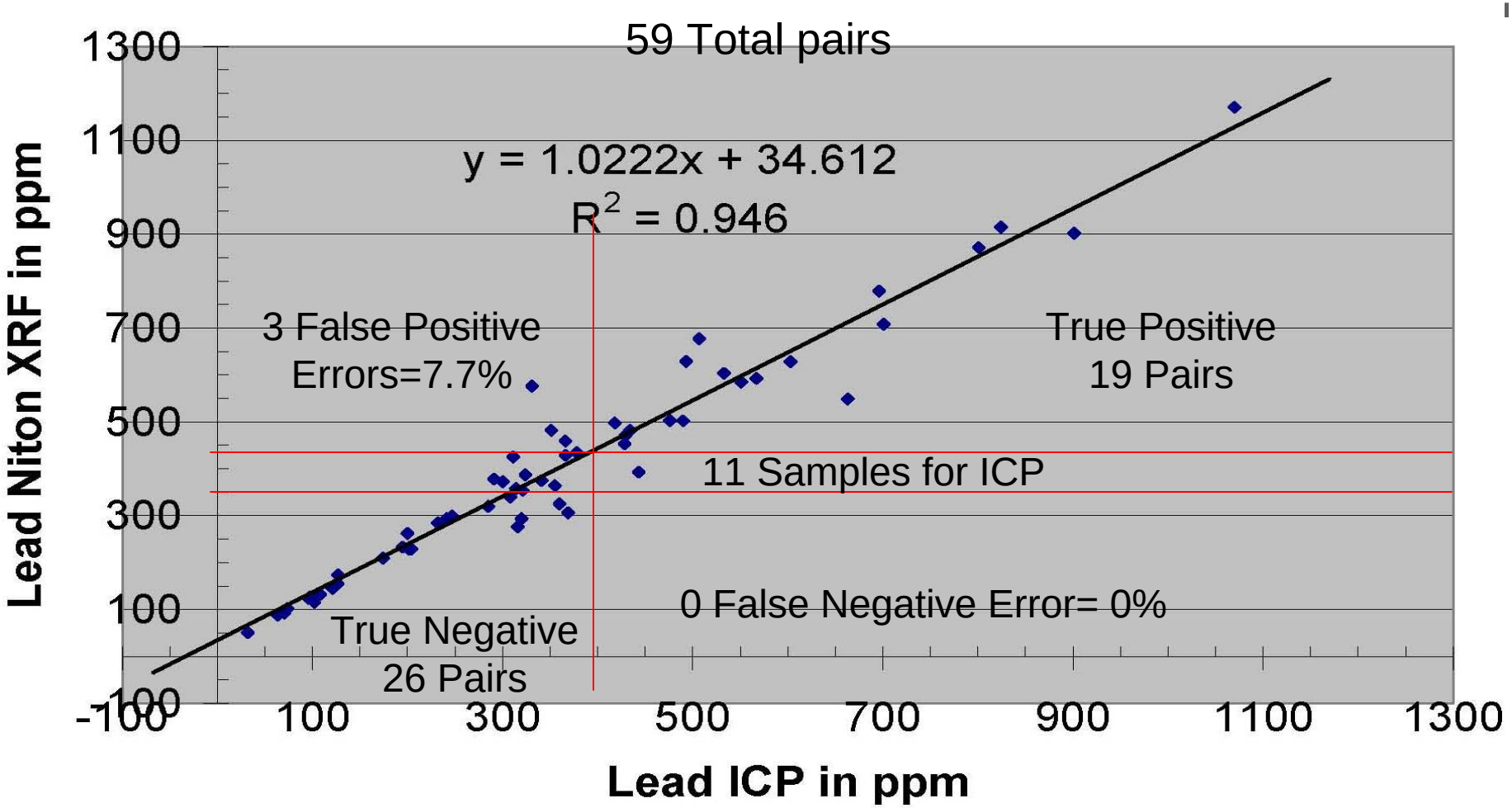


Lead Niton vs. ICP

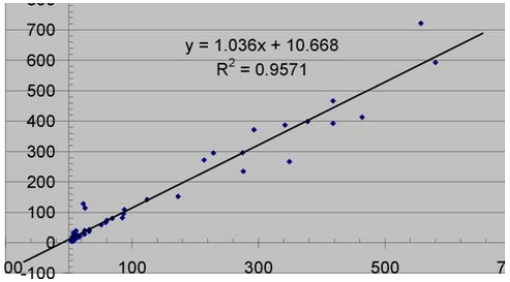
59 Total pairs

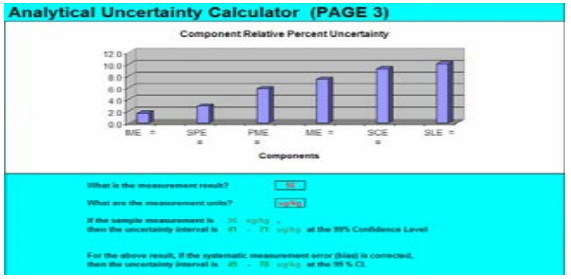


3 Way Decision Structure With Region of Uncertainty



DMA Benefits





- Augment planned data collection
- Identify uncertainties, develop strategies to manage these
- Test preliminary CSM
- Test drive decision support tools
- Develop relationships between visual observations and direct sensing tools
- Flexibility to change tactics based on DMA rather than full implementation
- Establish initial decision logic for dynamic work strategy
- Evaluate existing contract mechanisms
- Optimize sequencing, load balance, unitizing costs

Defining a Dynamic Work Strategy

Planning for Dynamic Work Strategies

- Sequencing
- Scheduling
- Segmenting or Staggering
- Traditional vs. streamlined work plans
- Decision logic diagrams
- Data management
- Tracking

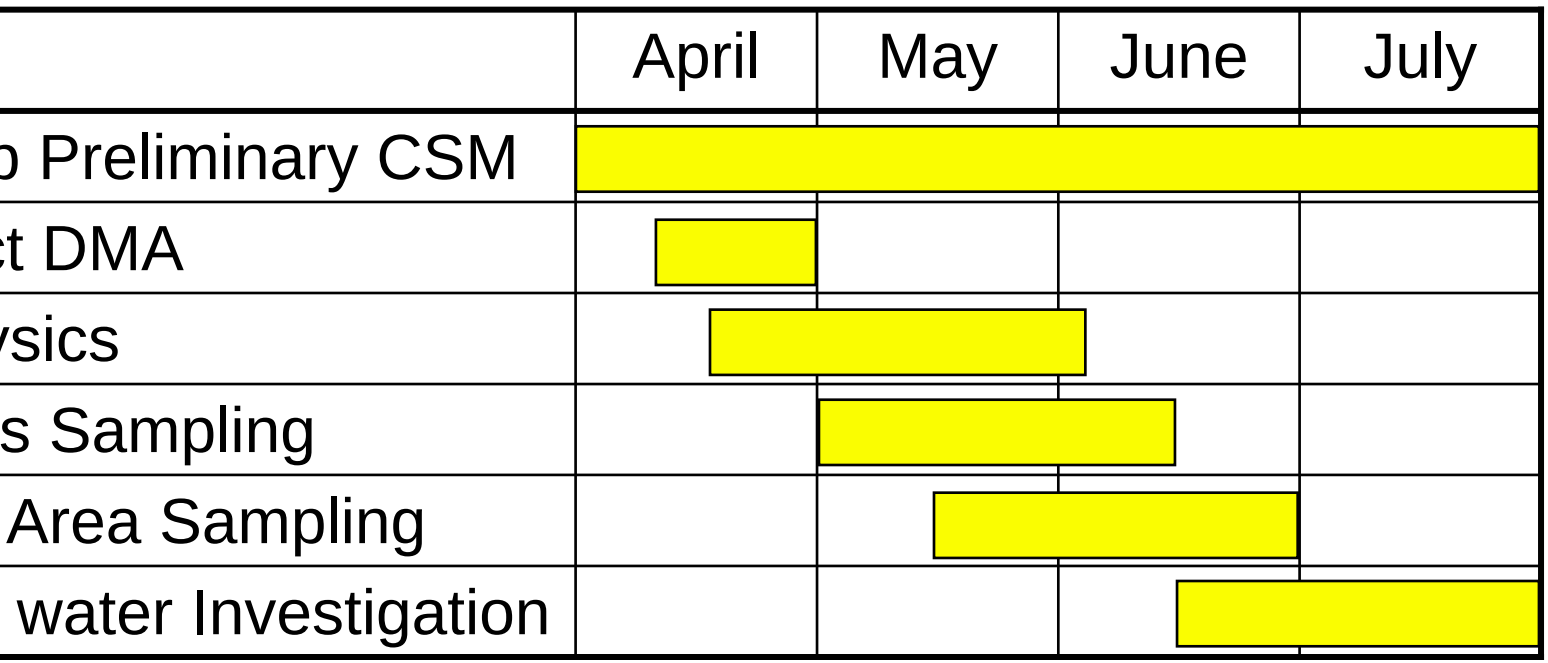
Dynamic Work Strategies

Use a logical sequencing of activities and technologies to optimize project resources

- **Geophysical data**
- **Soil gas methods**
- **Probes and sensors**
- **Test kits**
- **Fixed lab methods**
- **Physical properties**

Project Sequencing

Task	April	May	June	July
Develop Preliminary CSM				
Conduct DMA				
Geophysics				
Soil-Gas Sampling				
Source Area Sampling				
Ground water Investigation				



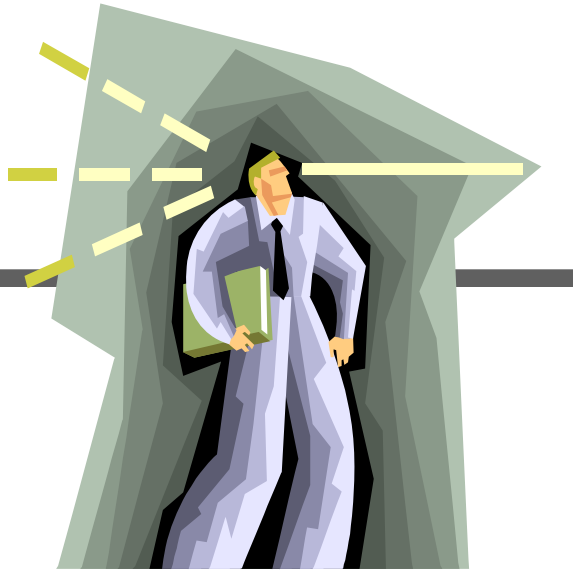
- Real time data management is essential

Streamlining Work Plans

Traditional vs. Streamlined Work Plans

- The general approach is agreed to prior to writing the work plans
- Data from probes and field-based instruments used to manage uncertainty
- QA/QC is focused where most needed
- Data is managed and assessed real-time
- Results are shared real-time

Why Use Them?



- Cuts production cost and time
- Ensures maximum efficiency
- Focuses QA/QC where most needed
- Easy to use and understand
- Allows for changes to be made easily
- Expedites review and approval process

Typical Outline for a Streamlined Work Plan (FSP/QAPP/HSP)

- Preliminary CSM
- Roles and responsibilities
- Decision logic diagrams (field and QC)
- Data collection and management
- Data assessment
- Communication
- SOPs
- Health and safety

The Big Picture: Data Flow & Tools

Collect Data

QA/QC

Store Data
Process Data

Scriblets

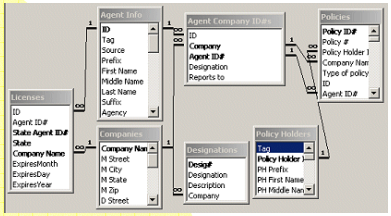
Forms II Lite

R5 EDD,SEDD

Field tools (eg XRF)

Field Database (Scribe)

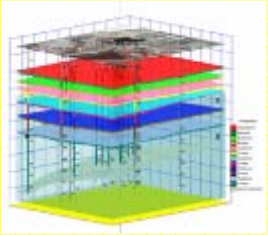
Regional Data Repository (WQX/STORET, EQuIS)



Database

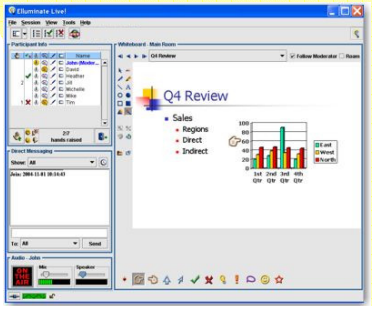
Field Data

Lab Data



Evolving Conceptual Site Model

Communicate



Scribe.net

EPA OSC Website

Quickplace

Collaboration Pages

Web Conferencing

Distance Collaboration

Make Decisions

MAROS

F/S Plus

FIELDS Tools

VSP

SADA

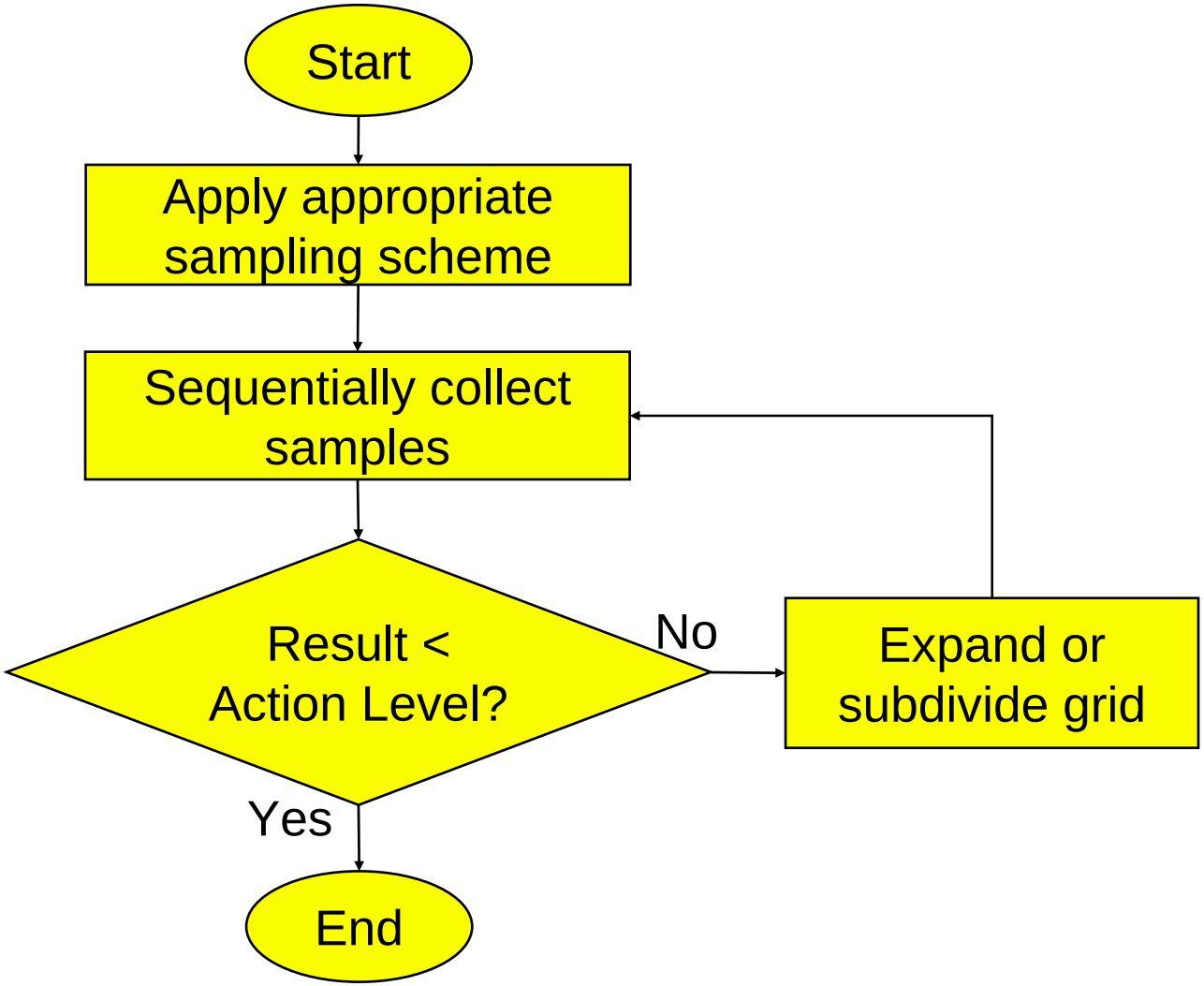
DST Matrix

EVS

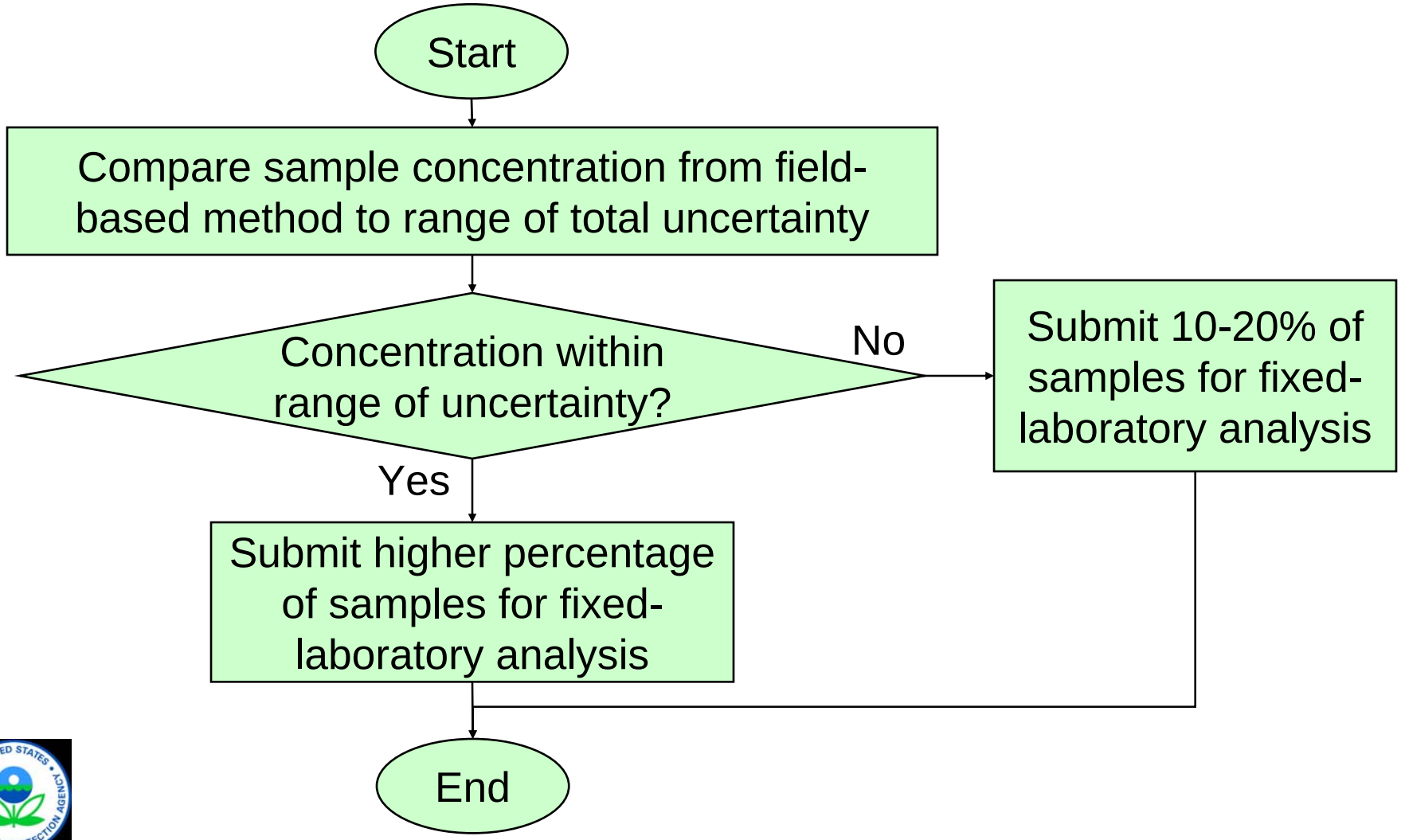
Decision Support Tools

Data Visualization Tools

Decision Logic Diagrams for Delineation



Quality Control Logic Diagrams



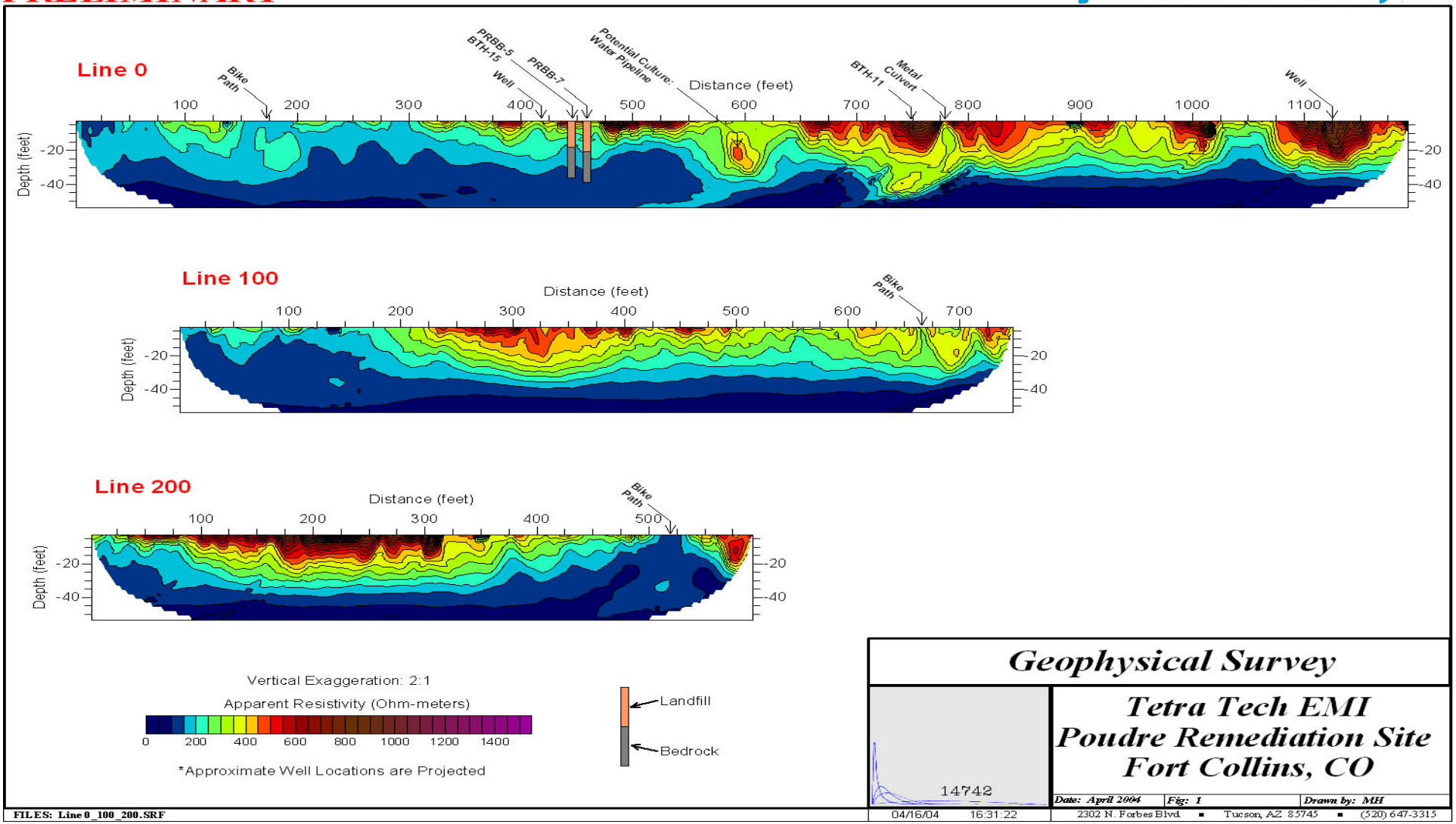
Real-Time Measurements

- Geophysical data
- Soil gas methods
- Probes and sensors
- Test kits
- Fixed lab methods
- Physical properties

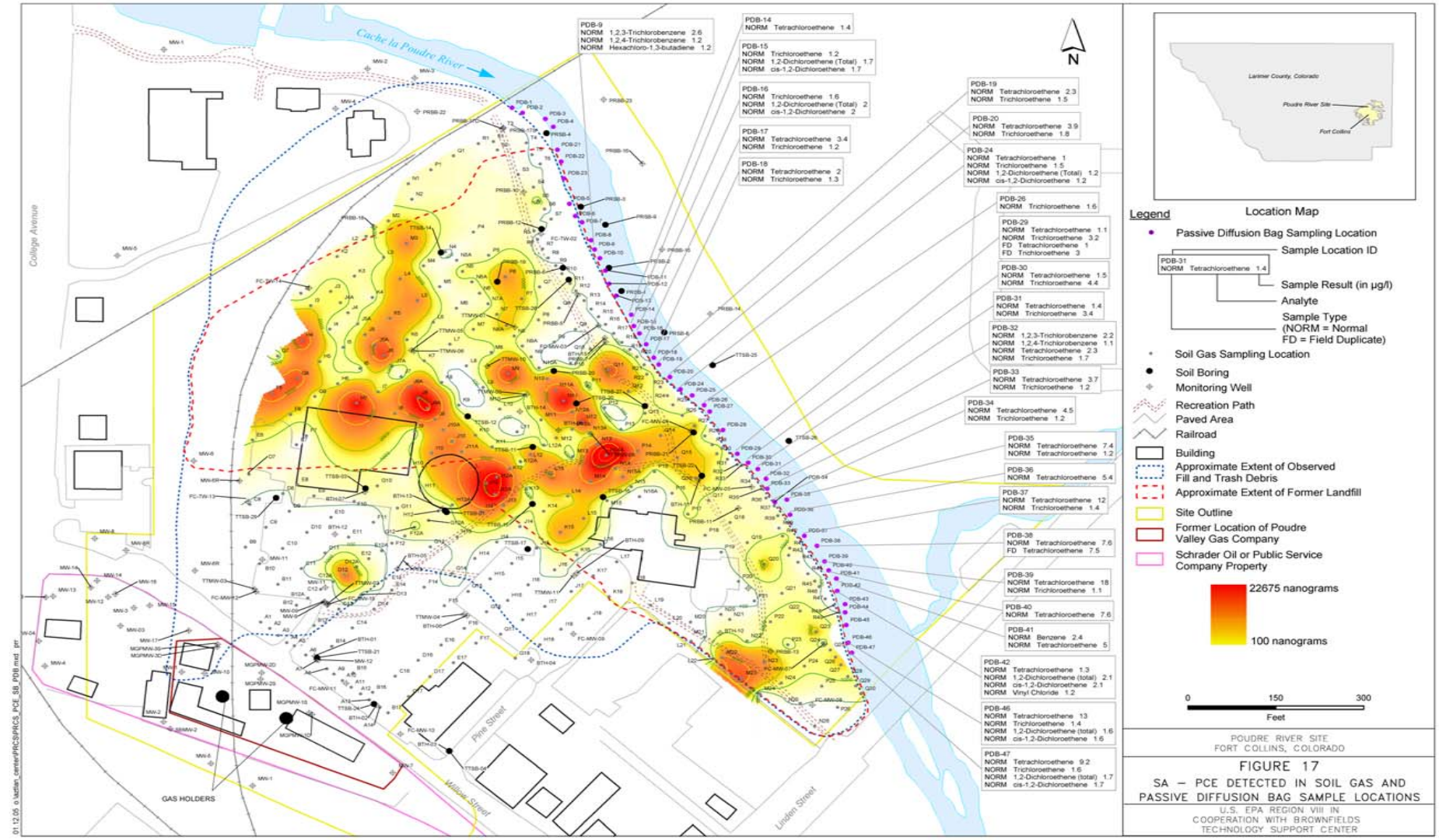
Resistivity Survey

PRELIMINARY

hydroGEOPHYSICS, Inc.



Passive Soil Gas Survey

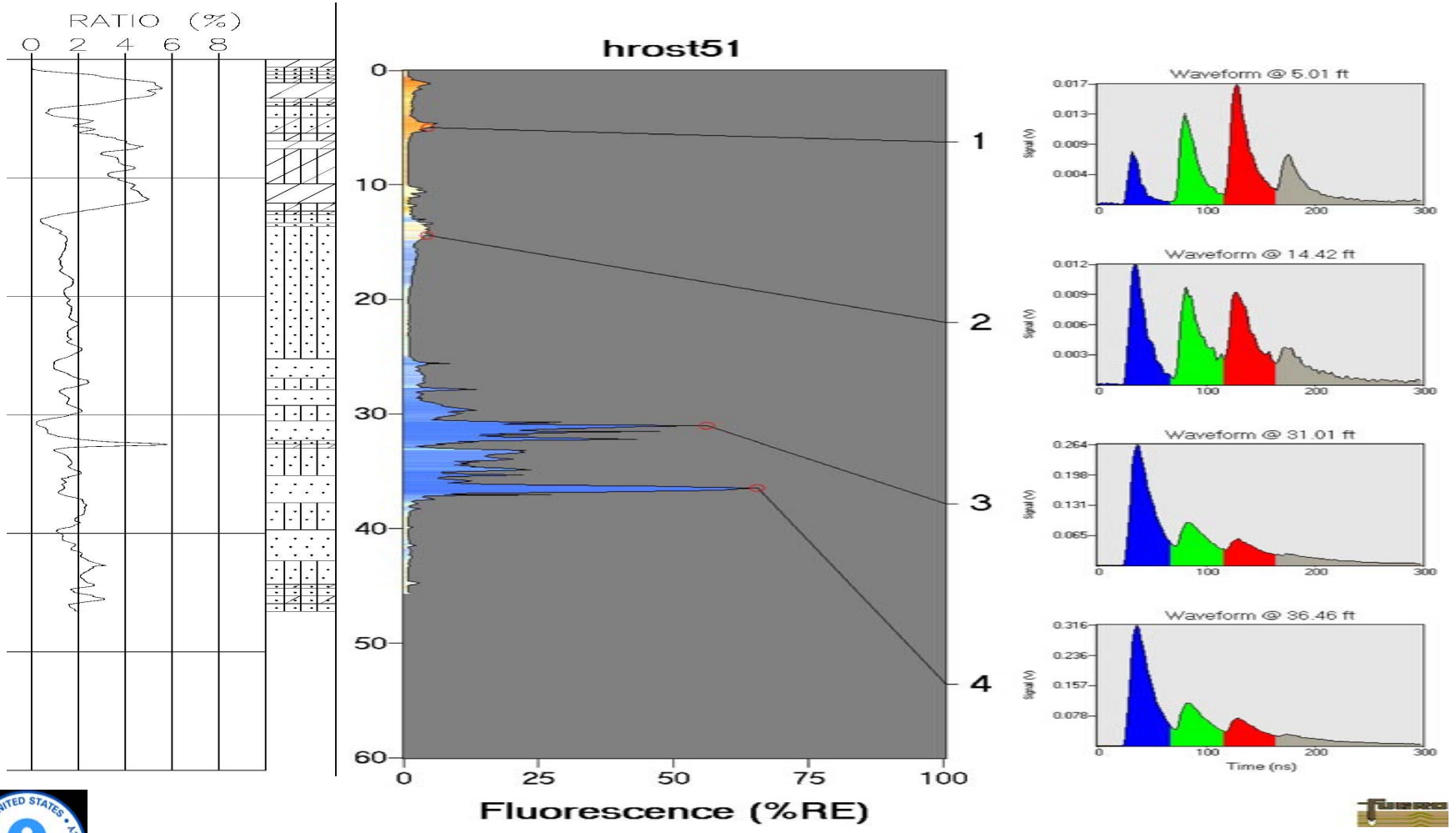


Subsurface Sensor Systems

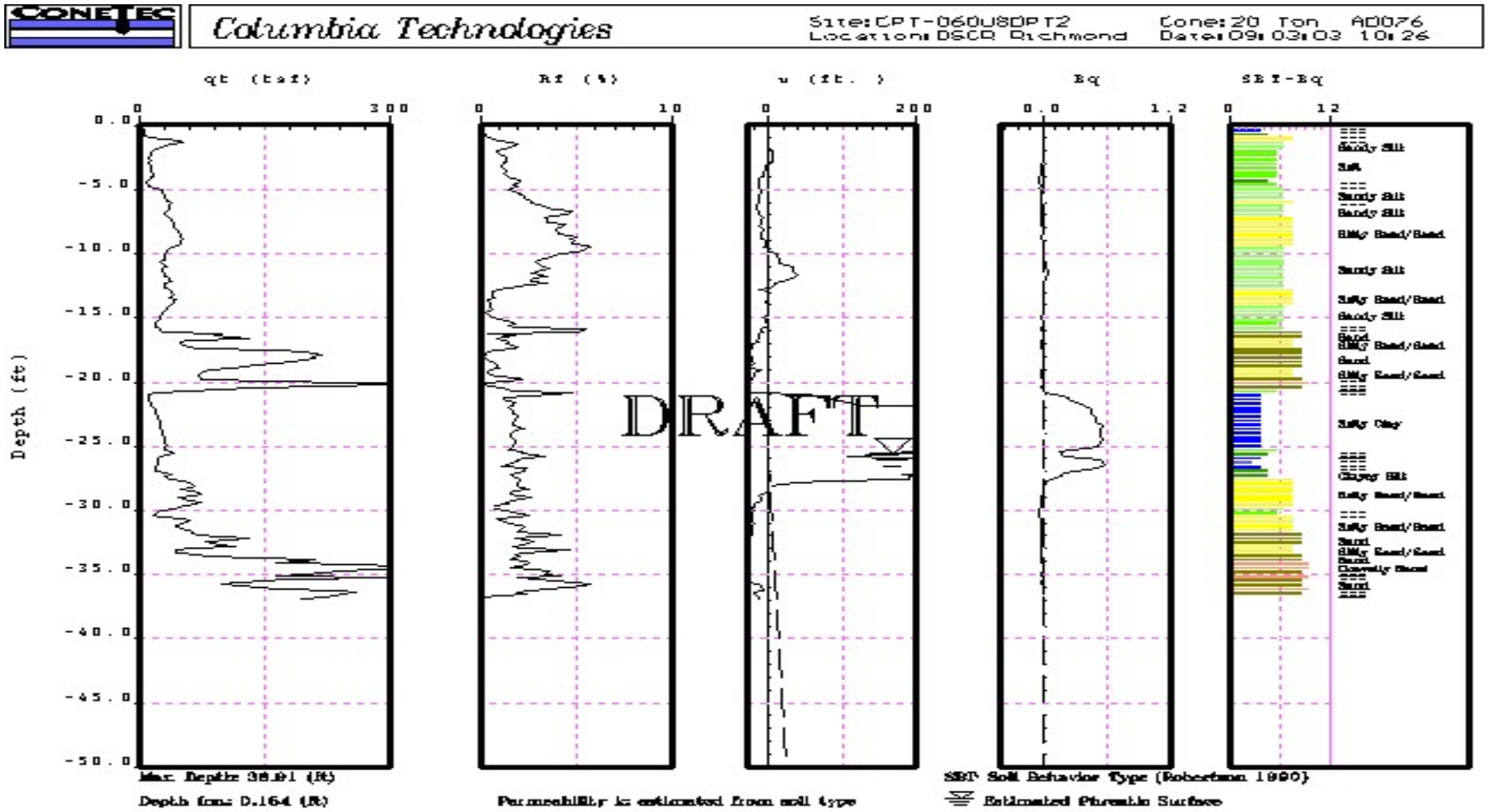
Sensors		Target Data
Membrane interface probe	➡	**Volatile organic compounds**
Laser induced fluorescence	➡	**POL Hydrocarbons**
Fuel fluorescence detectors	➡	**POL Hydrocarbons**
Cone penetrometer	➡	**Soil & water characteristics**
Neutron/gamma monitors	➡	**Radiation monitoring**

New Developments	Permeameter	➡	Hydraulic conductivity
	Haloprobe	➡	DNAPL chlorinated solvents
	Polymers	➡	Chlorinated solvents/energetics

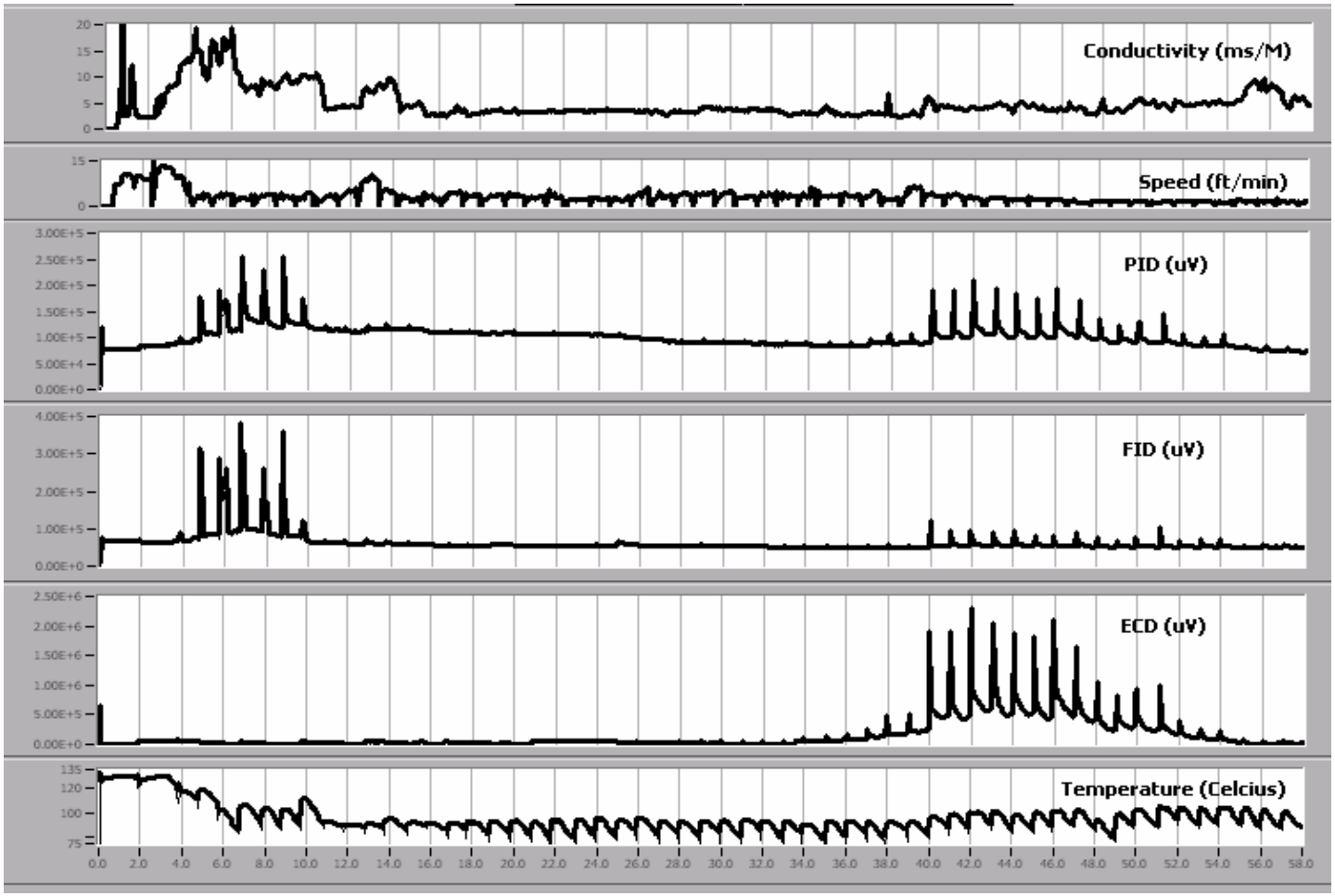
Laser Flourescence and CPT Results



Cone Penetrometer Data



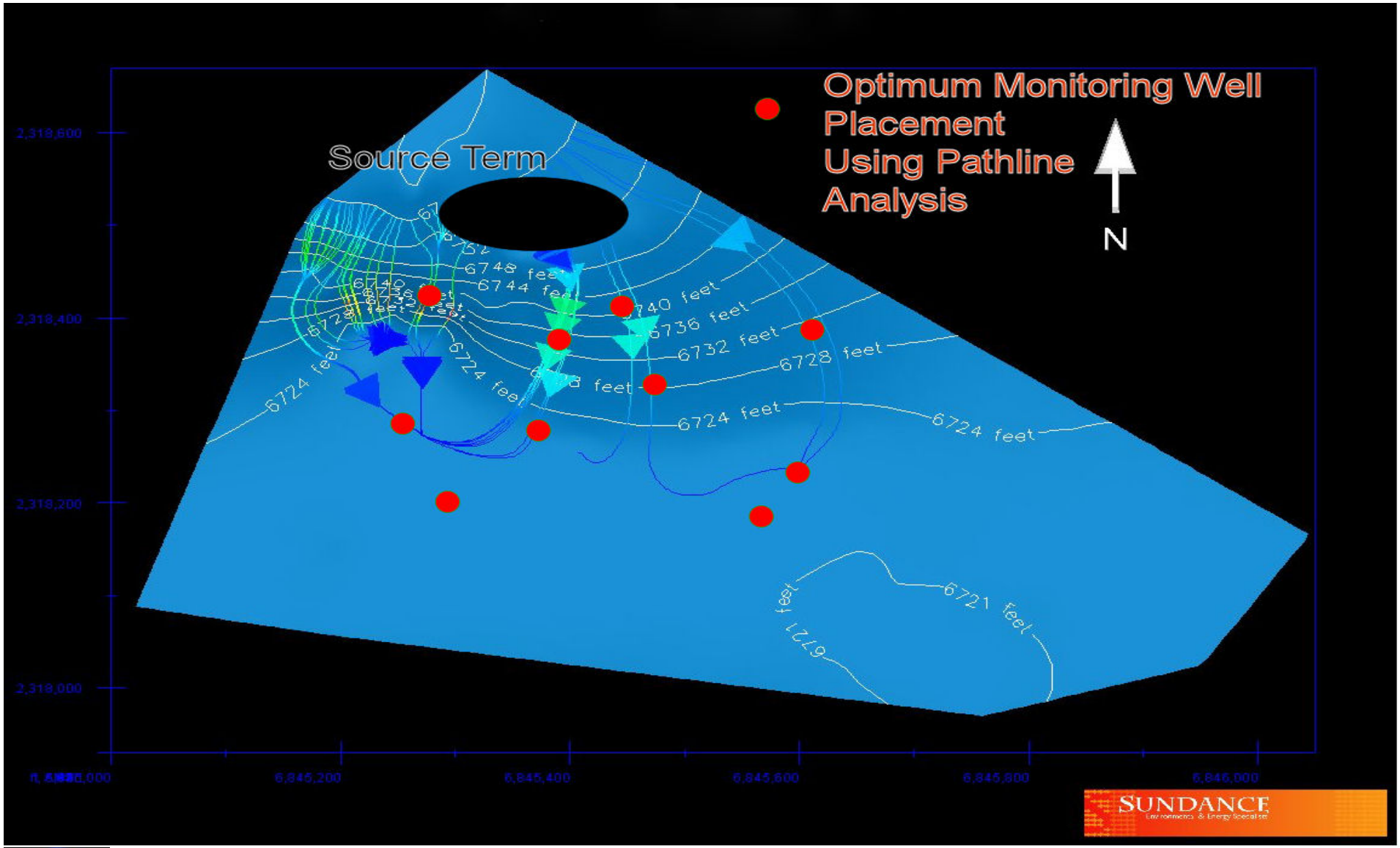
MIP – Multiple Channel Data Sets



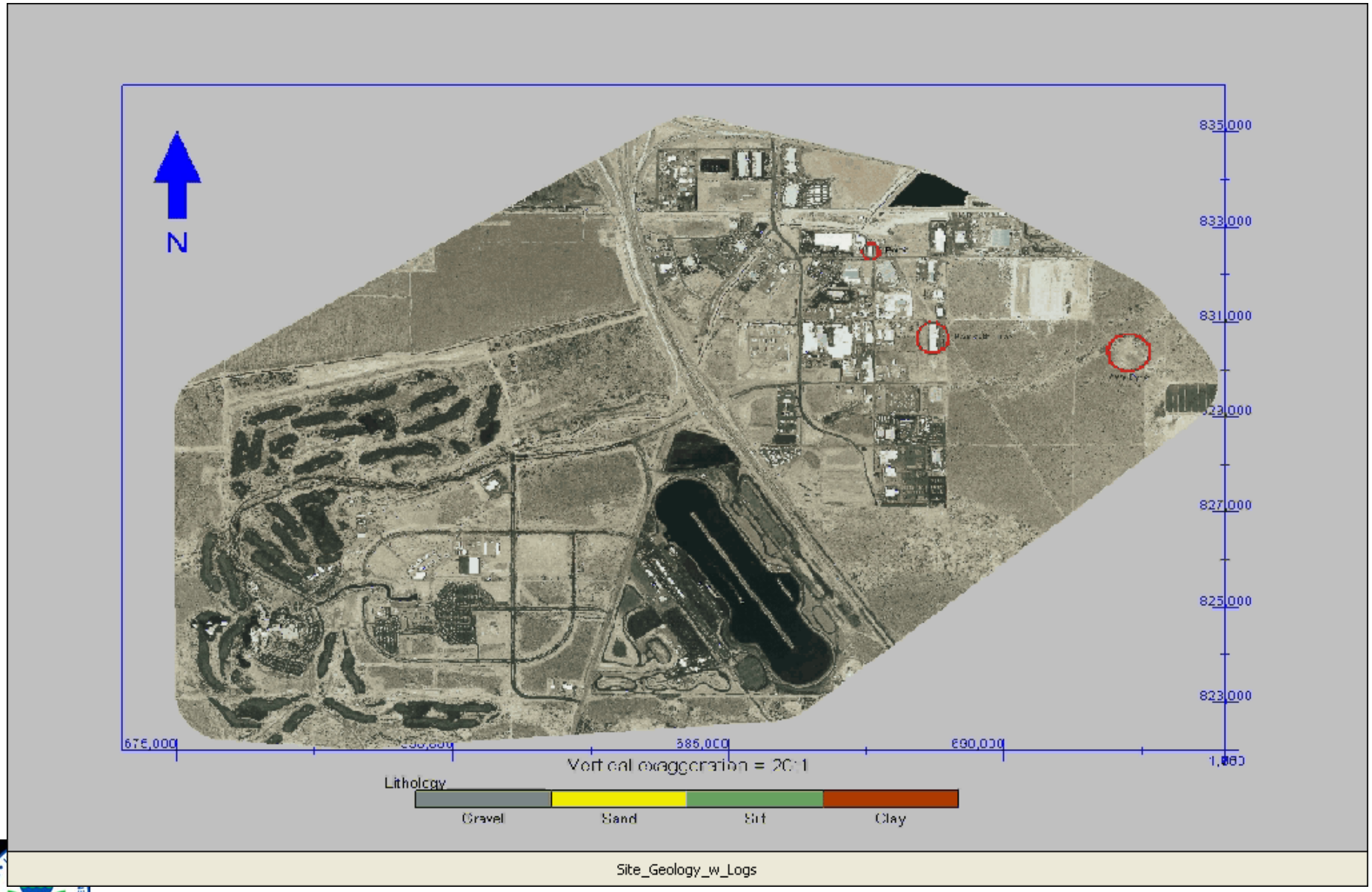
Testing the CSM

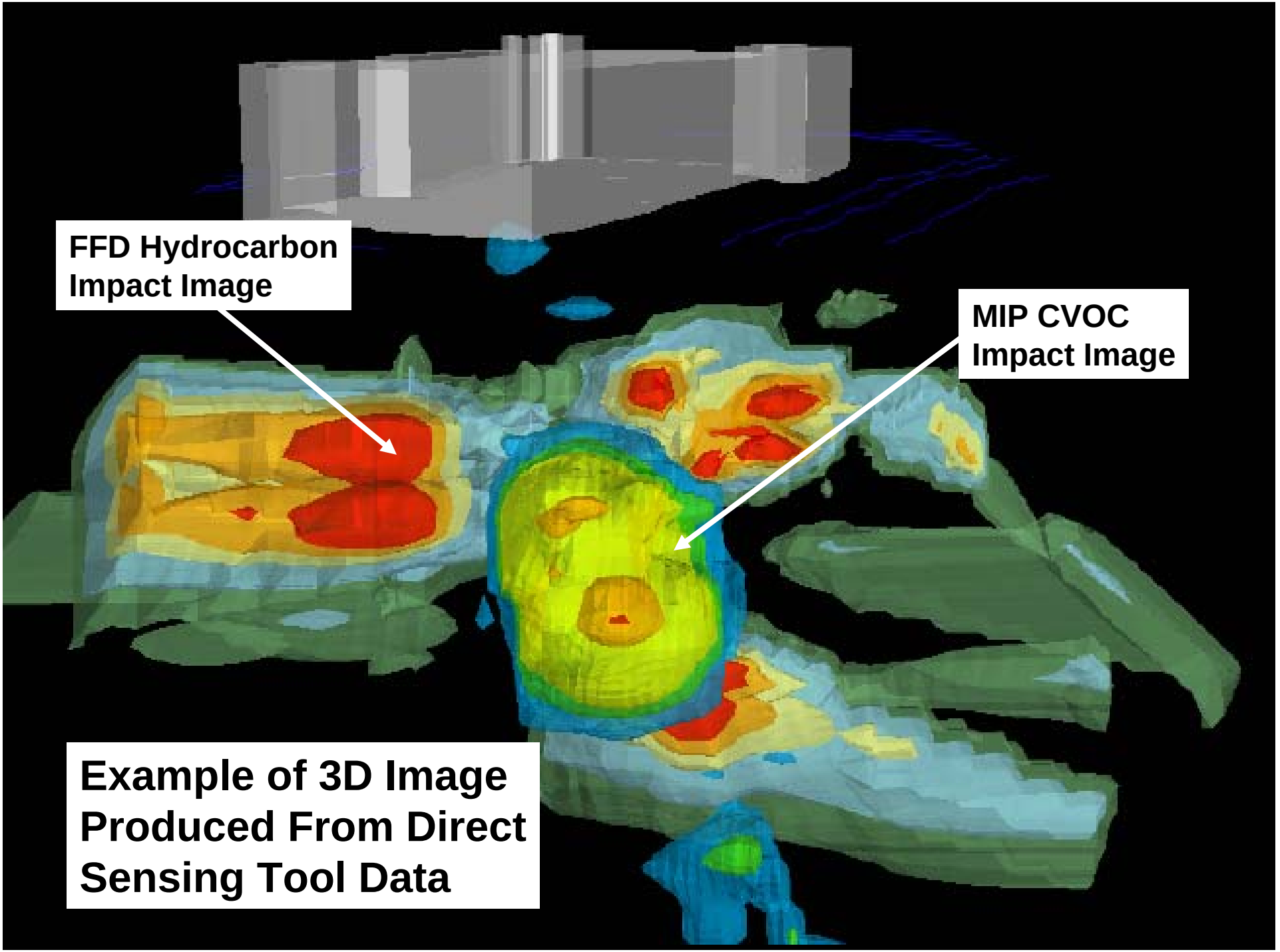
- Testing Critical Assumptions
  - » Hydrogeology
  - » Geology
  - » Contaminants
  - » Remedies
  - » Exit strategy

Model Optimized Well Locations

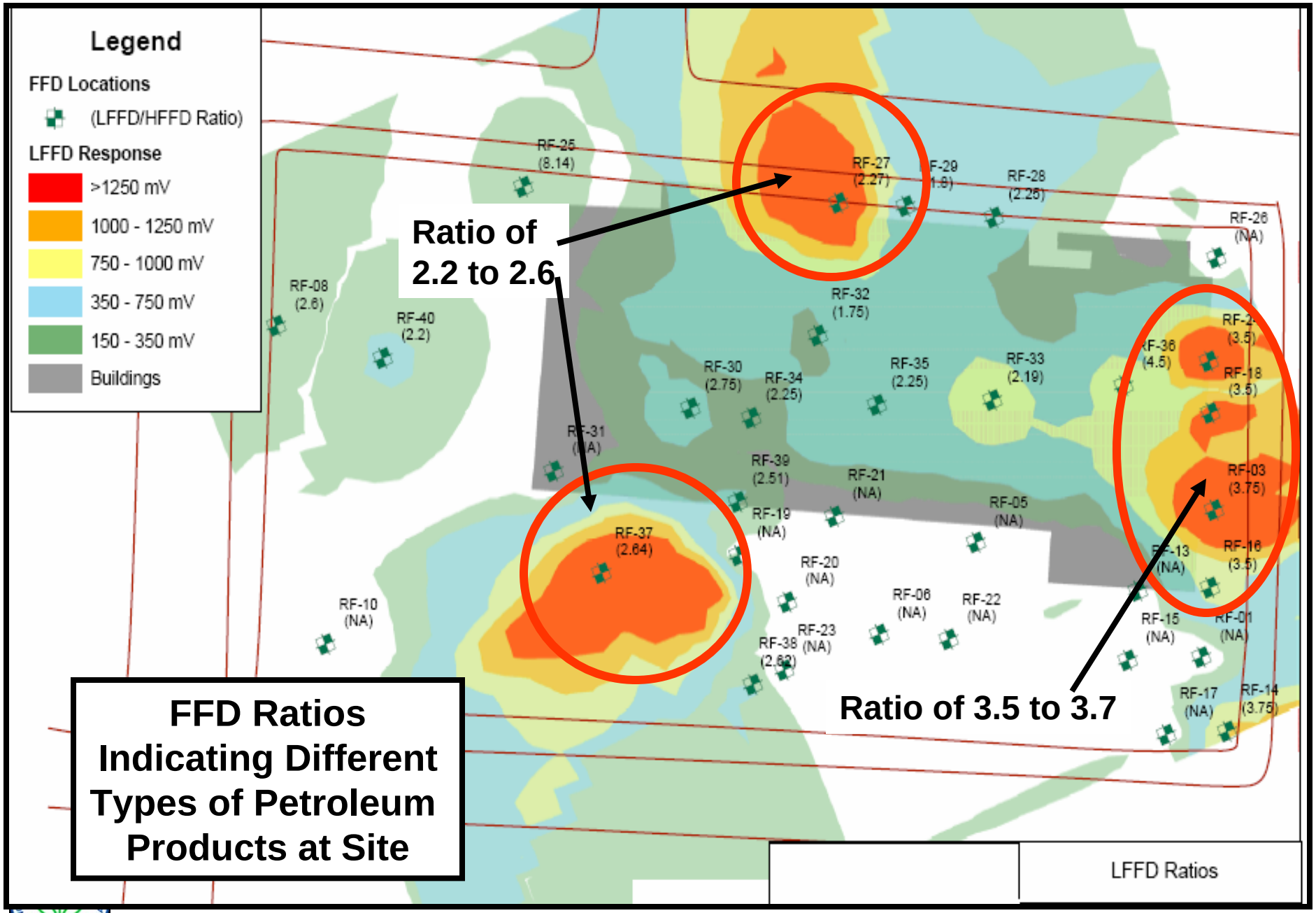


3-Dimensional Geologic Cut-away

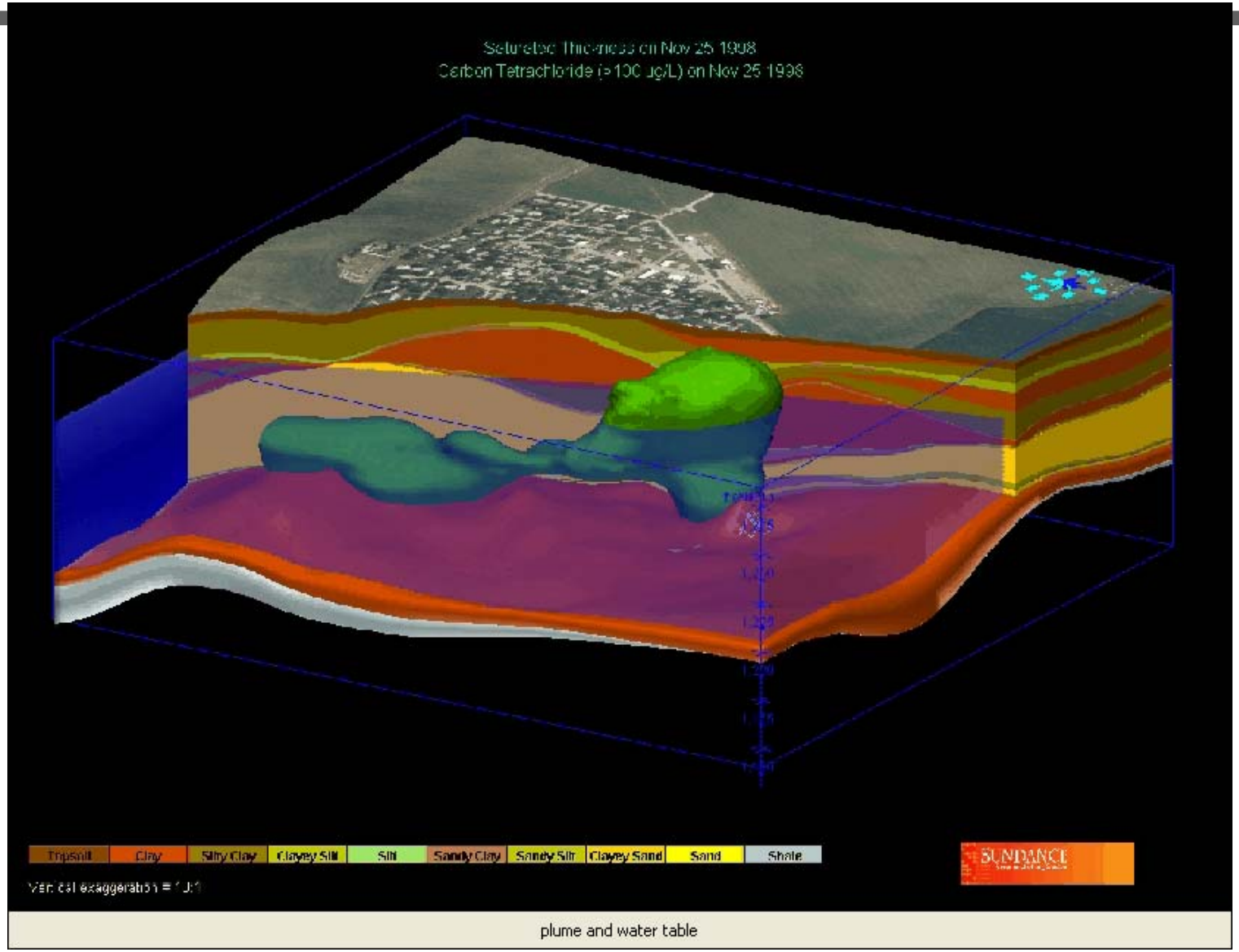




Example of 3D Image Produced From Direct Sensing Tool Data

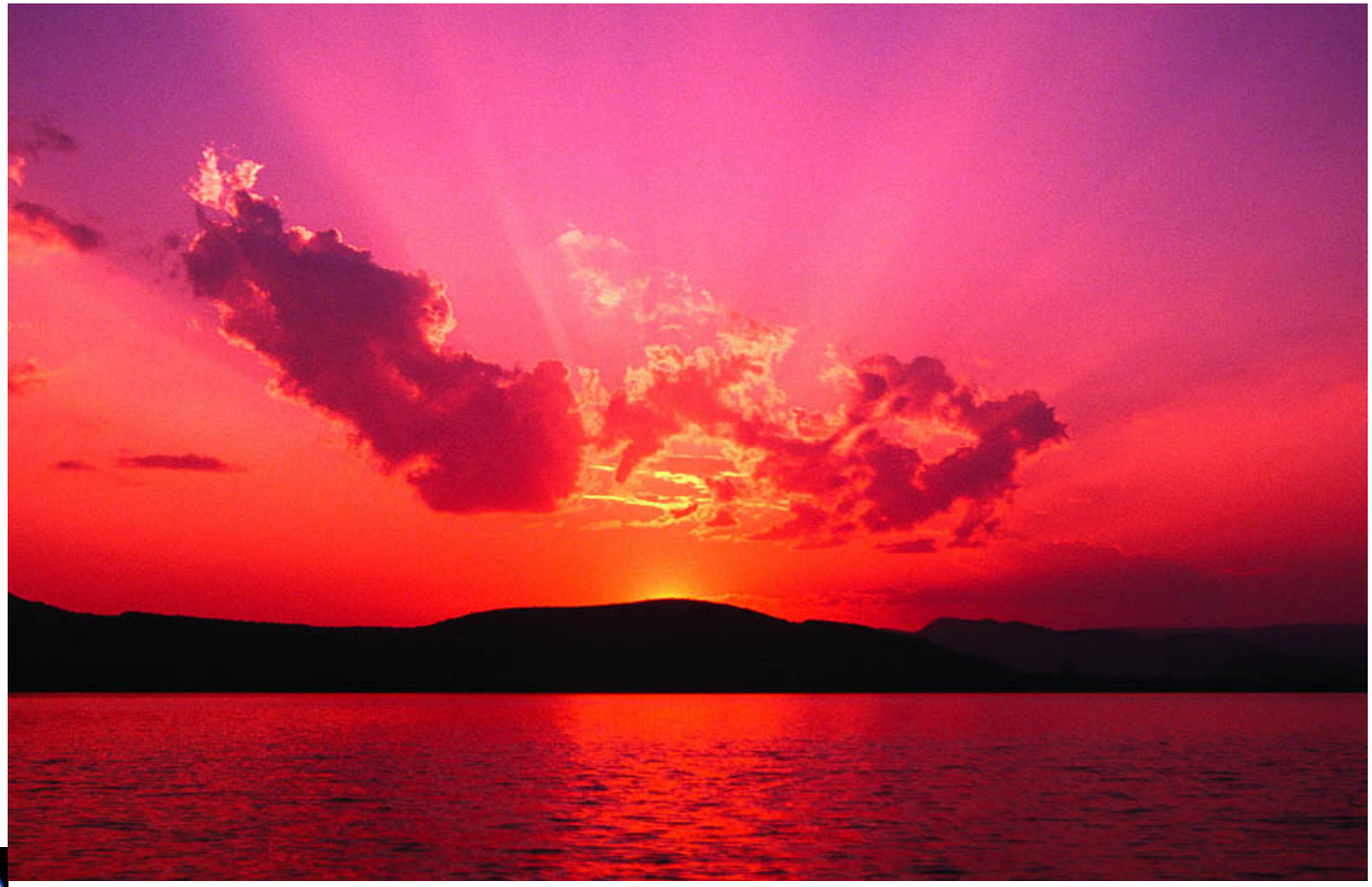

Legend
FFD Locations
(LFFD/HFFD Ratio)
LFFD Response
>1250 mV
1000 - 1250 mV
750 - 1000 mV
350 - 750 mV
150 - 350 mV
Buildings
Ratio of 2.2 to 2.6
Ratio of 3.5 to 3.7
FFD Ratios Indicating Different Types of Petroleum Products at Site
LFFD Ratios
RF-25 (8.14)
RF-27 (2.27)
RF-28 (2.26)
RF-26 (NA)
RF-08 (2.6)
RF-40 (2.2)
RF-32 (1.75)
RF-30 (2.75)
RF-34 (2.25)
RF-35 (2.25)
RF-33 (2.19)
RF-36 (4.5)
RF-18 (3.5)
RF-03 (3.75)
RF-31 (NA)
RF-39 (2.51)
RF-21 (NA)
RF-05 (NA)
RF-19 (NA)
RF-37 (2.64)
RF-20 (NA)
RF-13 (NA)
RF-16 (3.5)
RF-10 (NA)
RF-06 (NA)
RF-22 (NA)
RF-23 (NA)
RF-38 (2.62)
RF-15 (NA)
RF-17 (NA)
RF-14 (3.75)

3-D Visualization Dynamic Visualizations for Ground Water Results Over Time for Chlorinated Solvents and Transport Models



plume and water table

Optimizing Remedies



Long Term Monitoring Optimization Methods

- Cost Effective Sampling
- Parsons Three Tiered
- MAROS (Monitoring and Remediation Optimization Software)
- GTS (Geo-statistical Temporal/Spatial Optimization Algorithm)
- Mathematical Optimization Methods

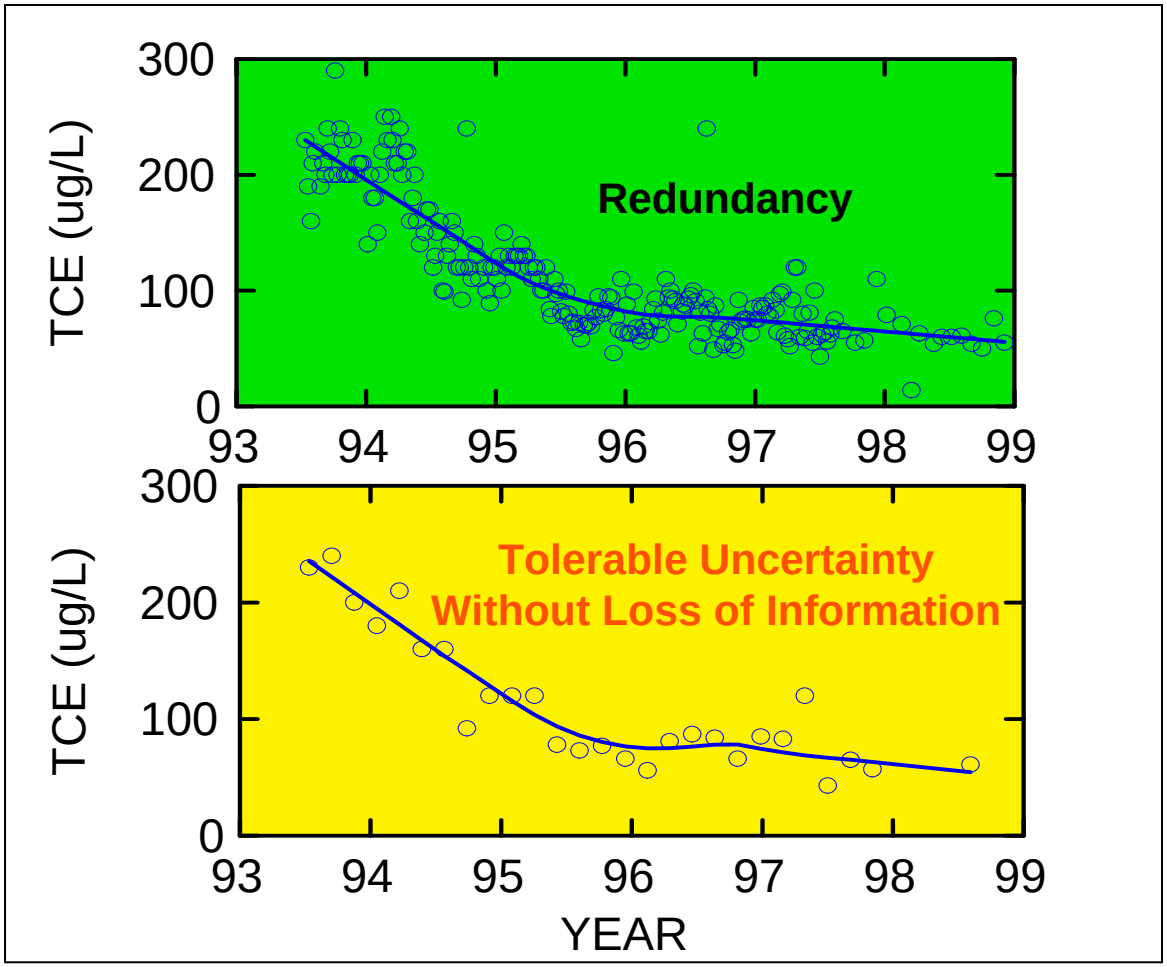
LNAPL Remediation Strategy – Conductivity Distribution

Blue = >10^{-2} cm^2/sec (2.5 acres) Teal = >10^{-3} cm^2/sec (23 acres)
Grey = >10^{-4} cm^2/sec (82 acres) Brown = > 10^{-5} cm^2/sec (179 acres)

Quantitative LTMO Involves Temporal Comparisons

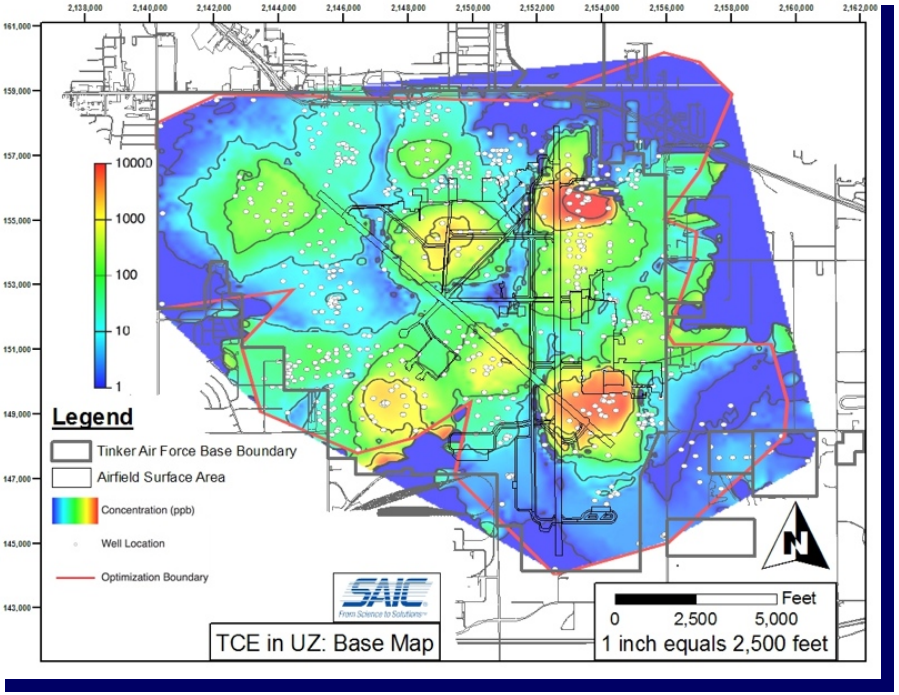
"Nice to have"
All Data
Samples = 240

"Essential"
90% Reduction
Samples = 27

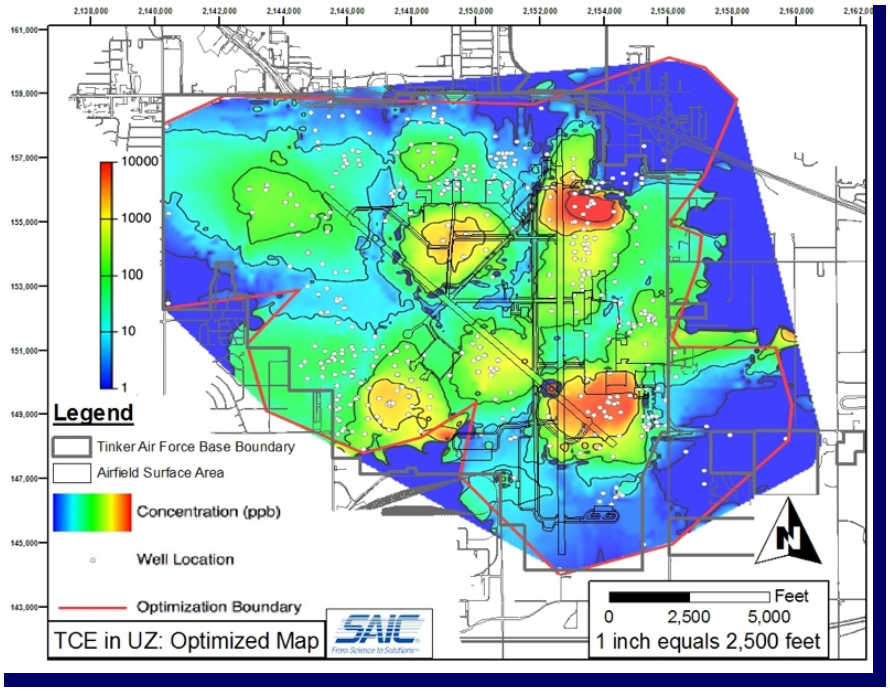


Tinker Spatial Comparison

Base Map (All Wells)



Optimized Map (38% less Wells)



Things to Avoid

- Not involving stakeholders
- Using untested field-based methods
- Prescribed sample locations
- Set percentages of QC samples
- Using generic and incomplete SOPs
- Not planning for real-time data collection, management, assessment, and communication

Resources

- Systematic Planning:
  - » Triad Systematic Planning Process: http://www.triadcentral.org/ref/doc/2_Adrianne.pdf
  - » Implementing Systematic Project Planning: http://www.triadcentral.org/ref/ref/documents/Triad_Systematic_Planning_Checklist_Oct06_.pdf
- Demonstration of Methods Applicability (DMA) Case Studies:
  - » Fort Lewis Small Arms Firing Range: http://www.triadcentral.org/user/doc/TPP-FortLewis-DMAMemo.pdf
  - » Marion Brothers Scrap Yard: http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=2
  - » Cos Cob Power Plant: http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=1

(continued)

Resources

- Brownfields Technology Support Center:
  - » http://www.brownfieldstsc.org/index.cfm
- Decision Support Tools Matrix:
  - » http://www.frtr.gov/decisionsupport/index.htm
- Clu-in FATE Technology Summary:
  - » http://clu-in.org/char/technologies/
- Ross Metals Case Study:
  - » http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=8
- Poudre River Case Study:
  - » http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=18
- Wenatchee Tree Fruit Site:
  - » http://www.triadcentral.org/tech/documents/Triadprimer.pdf
  - » http://www.triadcentral.org/ref/ref/documents/SCM-1.pdf

(continued)

Resources

- RTDF Resources:
  - » http://www.rtdf.org/
- Work plans for specific sites (see speaker notes for web links):
  - » Andrews AFB SAP/QAPP (available on the course CD), site information: http://www.epa.gov/reg3hwmd/npl/MD0570024000.htm
  - » Assunpink Creek Greenways Project Dynamic Work Plan Case Study: http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=3
  - » Vint Hill Farms Station Work Plan Case Study: http://www.triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=14

(continued)

Resources

- Data Management and Assessment
  - » Spatial Analysis and Decision Assistance (SADA): http://www.tiem.utk.edu/~sada/
  - » FIeld EnvironmentaL Decision Support (FIELDS): http://www.epa.gov/region5fields/
  - » Environmental Field Data Capture, Scribe and Scriblets: http://www.ertsupport.org/scribe_home.htm\
- Road Map to Long Term Monitoring:

  http://www.clu-in.org/download/char/542-r-05-003.pdf
- Remediation Optimization Training:

  http://www.cluin.org/search/default.cfm?search_term=ltmo&t=all&advlit=0
- Windrow Composting:

  http://www.wbdg.org/ccb/DOD/UFGS/UFGS%2002%2054%2021.pdf
  - » Applied at Hawthorne Army Depot: http://ndep.nv.gov/hwad/happ04.htm